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# Drainage Report

FOR

## Salisbury Park North Phase 1

AT

11700 N MOTSENBOCKER RD

PARKER CO 80134

FOR

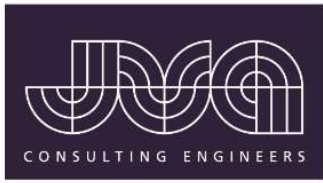
Town of Parker



**PARKER**  
C O L O R A D O

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November 20, 2024



**JVA, Incorporated**  
1319 Spruce Street  
Boulder, CO 80302  
303.444.1951  
info@jvajva.com

November 20<sup>th</sup>, 2024

[www.jvajva.com](http://www.jvajva.com)

Mr. Michael Walton, PE, CFM, Senior Development Review Engineer  
Town of Parker  
Engineering and Development  
20120 E. Main Street  
Parker, CO 80138

RE: Drainage Report for Salisbury Park North Phase 1  
JVA, Inc. Project No. 3752c

Dear Michael:

The following Drainage Report has been prepared for the for Lutheran High School Athletic Fields project. The stormwater report and drainage maps have been produced in accordance with the Storm Drainage and Environmental Policies for Parker, Colorado and the latest Mile High Flood Control District recommendations.

It is our understanding that the information provided herein meets the requirements specified in the Storm Drainage and Environmental Criterial Manual.

Please contact us if you have any questions regarding this submission.

Sincerely,

JVA, Inc.

---

Jacob A. Zeigler, P.E.  
Project Engineer



## Engineer's Statement:

This report for Salisbury Park North Phase 1 was prepared by me (or under my direct supervision) in accordance with the provisions of the Storm Drainage and Environmental Criteria Manual for the owners thereof. I understand that the City of Parker does not and will not assume liability for drainage facilities designed by others.

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Cody F. Gratny  
Registered Professional Engineer  
State of Colorado No. 45353

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Seal and Date

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# **Drainage Report**

FOR

## **Salisbury Park North Phase 1**

AT

**11700 N MOTSENBOCKER RD**

**PARKER CO 80134**

FOR

Town of Parker



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**JVA, Inc.**

### **Consulting Engineers**

1319 Spruce Street

Boulder, CO 80302

(303) 444-1951

JVA, Inc. Project No. 3350c

November 20, 2024

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Appendix A – Location Information

Appendix B – Hydrologic Computations

Appendix C – Hydraulic Computations

Appendix D – Mapping

The Town has received the floodplain development permit application associated with the proposed project from ICON Engineering. Please include a section in the report with discussion of the proposed development and impacts to the 100-year floodplain and description of who is providing the analysis. The report will need to reference and include the floodplain application and analysis in an appendix that includes a work map of the effective vs proposed floodplain with cross section analysis locations and floodway, calculations showing the impacts (delta of BFEs comparing proposed conditions model to corrected effective model) and the floodplain development permit application form.

Per State and Town regulations, any development within the Special Flood Hazard Area (SFHA), otherwise known as the 100-year regulatory floodplain, which increases the base flood elevations more than 0.50-feet shall require a CLOMR be submitted on the community's behalf. Any development which increases or decreases the base flood elevations more than 0.30-feet shall require a LOMR be submitted on the community's behalf.

Per State and Town regulations, any development within the FEMA Floodway which results in an increase or decrease in base flood elevations above 0.00-feet shall require a CLOMR and LOMR be submitted on the community's behalf.

# DRAINAGE REPORT

## Salisbury Park North Phase 1

### I. General Location and Description

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The following report details the drainage design for Phase 1 of the Salisbury Park North Project. As described in the Salisbury Park North Master Drainage Report, this project will be constructed in four phases. Phase 1 of the project will include the construction of four baseball fields with supporting dugouts, bull pens, and batting cages. A centralized plaza will be constructed within the center of the four baseball fields that will contain bleachers and facilities buildings. In addition to the baseball fields, there are two proposed multipurpose fields. Parking will be built south of the multipurpose fields and east of the northeast baseball diamond. Five detention ponds will be built to provide WQCV for this portion of the site.

In general, the proposed development of Phase 1 will result in a 37.2% of imperviousness. A summary of the historic and developed impervious values is below:

Please provide calculations for all 5 ponds. There are 4 ponds included in the calculations within the drainage report.

Table 1 - Impervious Surface Summary

	Site Area (acres)	Imperviousness
Historic	75.57	5.8%
Phase 1 Developed	38.86	43%
Master Plan Developed	46.62	51.4%

### II. Drainage Basins and Sub-basins

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#### A. Major Basin Description

The project site is located within the Cherry Creek Watershed. In general, the proposed development will match historic drainage patterns. Stormwater generally flows from the south to the north across the site. A network of proposed water quality basins will be constructed along the northern extents of the proposed site. Stormwater will be treated for water quality in these basins before it is discharged along historic drainage paths into Cherry Creek via storm sewer and overland flow.

#### B. Site Sub-Basin Description

The proposed site has been divided into major basins with minor sub-basins. The basin delineations are shown within the Developed Drainage Map with corresponding design points for each basin. The naming convention for these basins generally matches the naming convention established in the Master Drainage Report. The pond that receives flows from Major Basin B in the Master Drainage Report will not be constructed in Phase 1; therefore, no basins in this report are labeled Basin B. The Developed Drainage Map is included in Appendix D.

**Basins A1-A8** (13.96 acres) are onsite disturbed areas which comprise the east half of the proposed site. Contained within these basins are proposed baseball fields, batting cages, the HQ building, pickleball courts, and associated parking. Runoff generated within these basins is tributary to proposed WQCV Pond A. Conveyance to this pond is achieved with a network of overland flow channels, storm lines, and culverts. Outfall from Pond A is directed to the north along a proposed swale into an existing drainage culvert, and ultimately into Cherry Creek. Major Basin A in this report is contained entirely within Major Basin A in the Master Drainage Plan.

**Basins C1-C4** (11.40 acres) are onsite disturbed areas that contain the drainage channel along the southern extent of the site, the two western baseball fields, and a parking area. Runoff generated within these basins is tributary to the proposed WQCV Pond C. A network of storm sewer and overland drainage channels will convey runoff to the Pond. Outfall from Pond C is directed along a proposed swale to an existing drainage culvert, and ultimately into Cherry Creek. Major Basin C in this report is contained entirely within Major Basin C in the Master Drainage Plan.

**Basins D1-D2** (7.70 acres) are onsite disturbed areas that contain two multi-purpose fields, a basketball court, a workout area, and associated walks and open spaces. Runoff generated within these basins is tributary to proposed WQCV Pond D. A network of storm lines will provide conveyance to the Pond. Outfall from Pond D is directed to the north along a proposed swale into an existing drainage culvert, and ultimately into Cherry Creek. Major Basin D in this report is contained entirely within Basins B1 and B2 the Master Drainage Plan.

**Basin E1** (1.92 acres) contains a drive isle and associated parking stalls along the west side of the site. In the phase one condition, runoff generated within this basin will flow to the north via curb & gutter into proposed WQCV Pond E. Outfall from Pond E will be directed into a bypass swale which runs to the north into an existing drainage culvert, and ultimately into Cherry Creek. This basin is contained within Basin A7 on the Master Drainage Plan.

**Basin ALT 1** (1.02 acres) contains the proposed Alternate 1, which includes a community hub building and concrete walks. Runoff in this basin will flow to the proposed storm sewer which will convey flows to the WQCV Alt 1 Detention Pond. Basin ALT 1 in this report is equivalent to Basin B4 in the Master Drainage Plan.

**Basin OS1** (2.87 acres) contains a portion of the site which is flowing offsite, untreated. This basin contains some undisturbed native grasses, and some landscaped areas. A swale has been constructed in the northeastern portion of this basin which will capture all flows and convey it to a culvert passing under the road. Major Basin OS1 in this report is contained within Major Basin A in the Master Drainage Plan.

The drainage plan indicates that there are proposed storm runoff flows that are routed offsite and undetained. Please see Section 7.2.3 of the SDECM and provide discussion of why these portions of the are not able to be routed through the proposed detention facility. Compensatory storage will only be permitted in those cases where it is clearly impractical to route all runoff from the developed site through detention facility.

It is JVA's understanding that the work presented within this drainage report complies with all applicable Town of Parker and Mile High Flood District design standards. Point rainfall data that



## B. Stormwater Storage Facilities

The Town of Parker's Storm Drainage and Environmental Criteria Manual requires the implementation of full-spectrum detention. This approach is designed to control peak discharge across all runoff events, from frequent storms to the 100-year event, effectively replicating pre-development conditions. Due to site constraints onsite water quality ponds are proposed instead of full-spectrum detention. This variance along with any others is discussed in the Master Drainage Report.

The Water Quality Basin designs include one of two outlet structure designs. The first design is an outlet structure with a water quality orifice plate and overflow pipe. The second design is a weir with a water quality orifice plate and an overflow weir. This approach meets the Town's stormwater management requirements for water quality and keeps fill within the adjacent floodplain as minimal as possible.

Ponds D, E and ALT 1 will only be constructed for Phase 1 and Phase 2. In Phase 3, these ponds will be removed, and runoff will be redirected to a different pond. Ponds A and C will exist in their current condition in the final condition, and therefore have been sized for a larger flow than they will receive in this phase. A summary of the proposed detention basin volumes is shown in Table 2 below:

*Table 2 – Detention Basin Volumes*

<b>Basin ID</b>	<b>Watershed Area (ac)</b>	<b>Provided Volume (ac-ft)</b>	<b>Required Volume (ac-ft)</b>	<b>WQ Peak Outflow Q (cfs)</b>
Pond A	13.96	0.777	0.222	0.2
Pond C	11.40	0.384	0.169	0.1
Pond D	7.70	0.229	0.134	0.1
Pond E	1.92	0.100	0.038	0.0
ALT 1	1.00	0.039	0.020	0.0

## C. Water Quality & Permanent Best Management Practices

This development is classified as a Tier 3 Development under the Town's Permanent BMP (PBMP) requirements, subjecting it to the most comprehensive PBMP standards outlined in the Town's regulations.

The PBMP proposed for this project includes multiple water quality control volume ponds, as specified in Section 7.2.1.2 of the Town of Parker's Storm Drainage and Environmental Criteria Manual. The design calculations given in this report, including outlet design, strictly adhere to the procedure outlined in Volume 3 of the Urban Storm Drainage Criteria Manual.

The design considers the site's soil conditions and geologic features, notably Type B soils with moderate infiltration potential, and aligns with the Town of Parker's regional drainage and stormwater quality plans.

Long-term operation and maintenance of the PBMPs will be the sole responsibility of the Town of Parker, with easements and legal provisions included in the final design to ensure access for operation, maintenance, and inspection.

This PBMP plan has been developed in full compliance with the Town of Parker's requirements for New Development, as defined in Section 1.4 of the Town's regulations, and meets all applicable standards for Tier 3 Developments.

## V. Conclusions

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### A. Compliance with Standards

The stormwater facilities and design proposed for the Salisbury Park North have been designed and analyzed in accordance with the City of Parker Storm Drainage and Environmental Criteria Manual, the Mile High Flood District recommendations set forth in the Urban Storm Drainage Criteria Manuals and engineering best practices within the State of Colorado. The proposed drainage design will maintain existing runoff conditions by attenuating and treating developed flows and reduce the potential for adverse effects downstream.

### B. Drainage Concept

The proposed stormwater management infrastructure and techniques are in substantial compliance with all applicable regulations and will improve existing site drainage conditions. The design incorporates strategic grading, Best Management Practices, and control measures to provide stormwater quality treatment and attenuate developed flows to mimic historic flows for a variety of return events. The improvements presented in this report are intended to improve existing conditions and minimize flood risk. It is believed that the proposed improvements will not adversely impact properties upstream or downstream, and do not adversely impact drainageways downstream.

## VI. References

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1. "Final Roadway Drainage Report for Dransfeldt Road Extension" Douglas County, Colorado, August 2023.
2. "Salisbury Park North Phase 1 Floodplain Development Permit Application" City of Parker, Colorado, November 2023.
3. "Storm Drainage and Environmental Criteria Manual", Town of Parker, Colorado, February 2014.
4. "Urban Storm Drainage Criteria Manual", Mile High Flood District, Latest Edition.
5. <https://www.fema.gov/flood-maps>. Accessed 14 May 2024.
6. <https://websoilsurvey.nrcs.usda.gov/app/>. Accessed 14 May 2024.
7. <https://fwsprimary.wim.usgs.gov/wetlands/apps/wetlands-mapper/>. Accessed 14 May 2024.

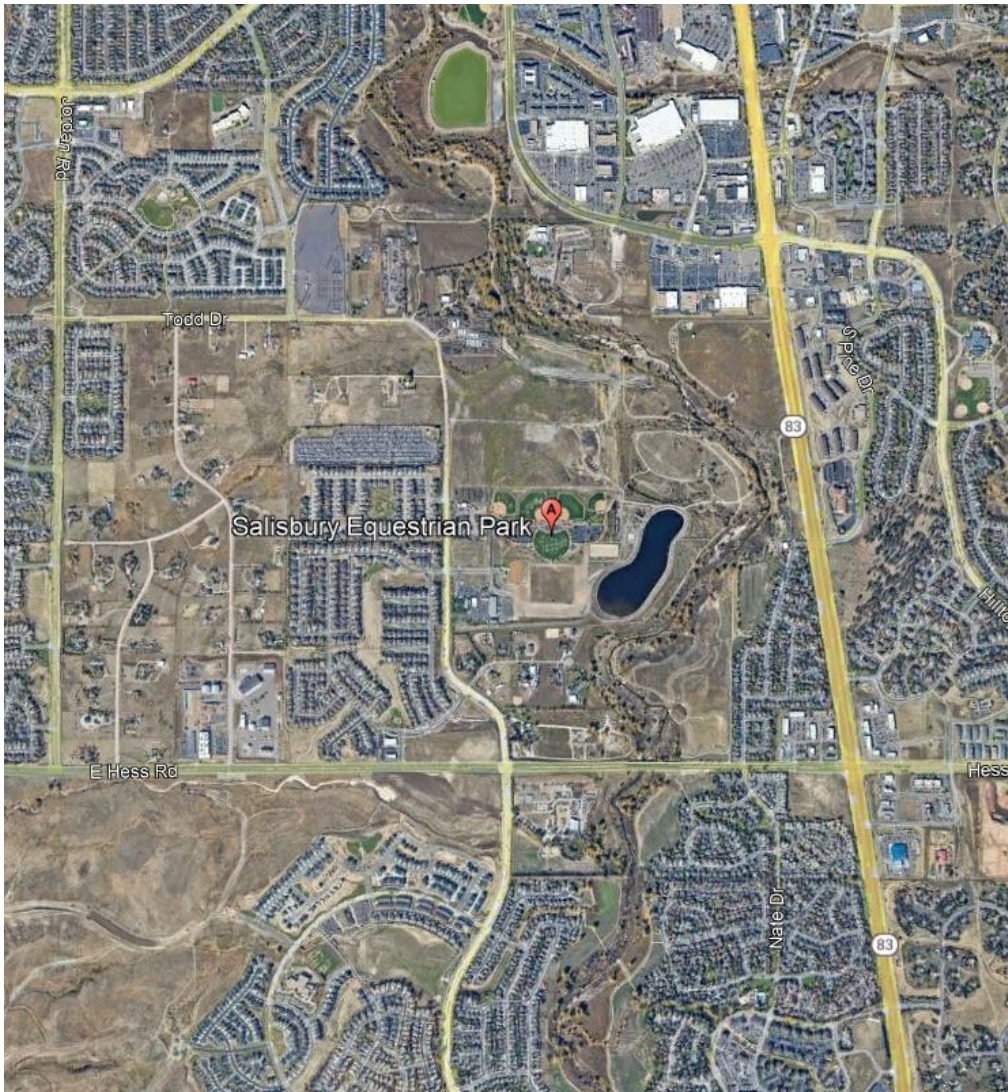
# **APPENDIX A – LOCATION INFORMATION**

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# Salisbury Park North

## Development

AT  
11700 Motsenbocker Road  
Parker, CO

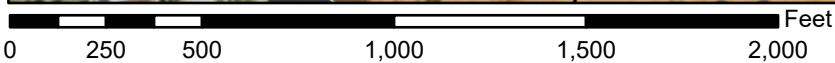
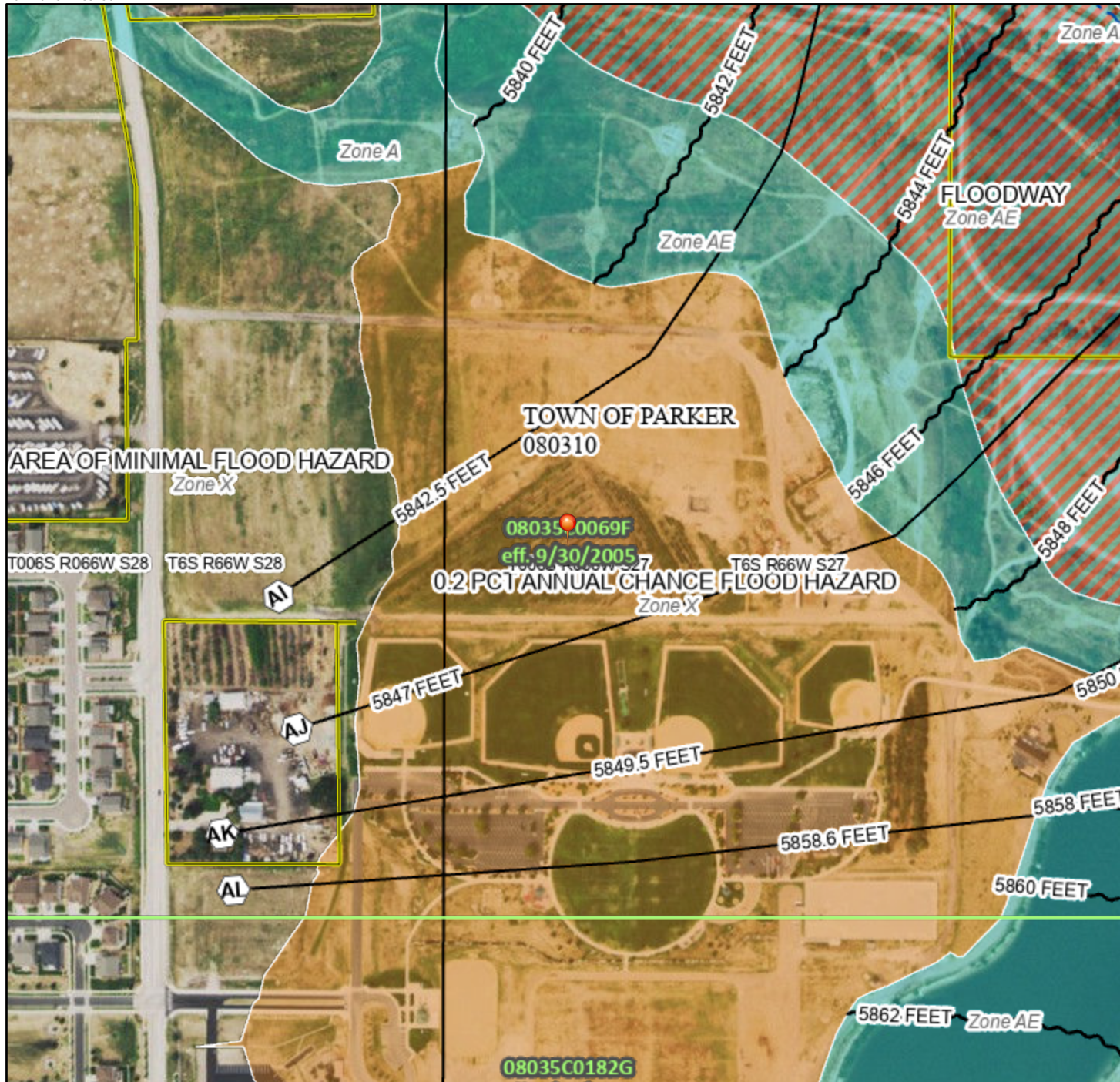


VICINITY MAP NOT TO SCALE

# National Flood Hazard Layer FIRMMette



104°46'43"W 39°30'24"N



1:6,000

104°46'6"W 39°29'56"N

Basemap Imagery Source: USGS National Map 2023

## Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS		Without Base Flood Elevation (BFE) Zone A, V, A99
		With BFE or Depth Zone AE, AO, AH, VE, AR
		Regulatory Floodway
OTHER AREAS OF FLOOD HAZARD		0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile Zone X
		Future Conditions 1% Annual Chance Flood Hazard Zone X
		Area with Reduced Flood Risk due to Levee. See Notes. Zone X
		Area with Flood Risk due to Levee Zone D
OTHER AREAS		NO SCREEN Area of Minimal Flood Hazard Zone X
		Effective LOMRs
GENERAL STRUCTURES		Area of Undetermined Flood Hazard Zone D
		Channel, Culvert, or Storm Sewer
OTHER FEATURES		Levee, Dike, or Floodwall
		20.2 Cross Sections with 1% Annual Chance Water Surface Elevation
MAP PANELS		17.5 Coastal Transect
		Base Flood Elevation Line (BFE)
		Limit of Study
		Jurisdiction Boundary
		Coastal Transect Baseline
		Profile Baseline
		Hydrographic Feature
		Digital Data Available
		No Digital Data Available
		Unmapped



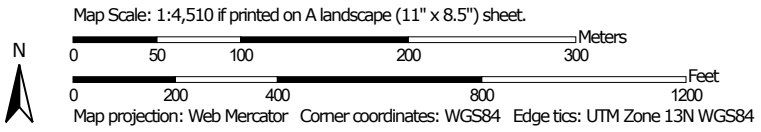
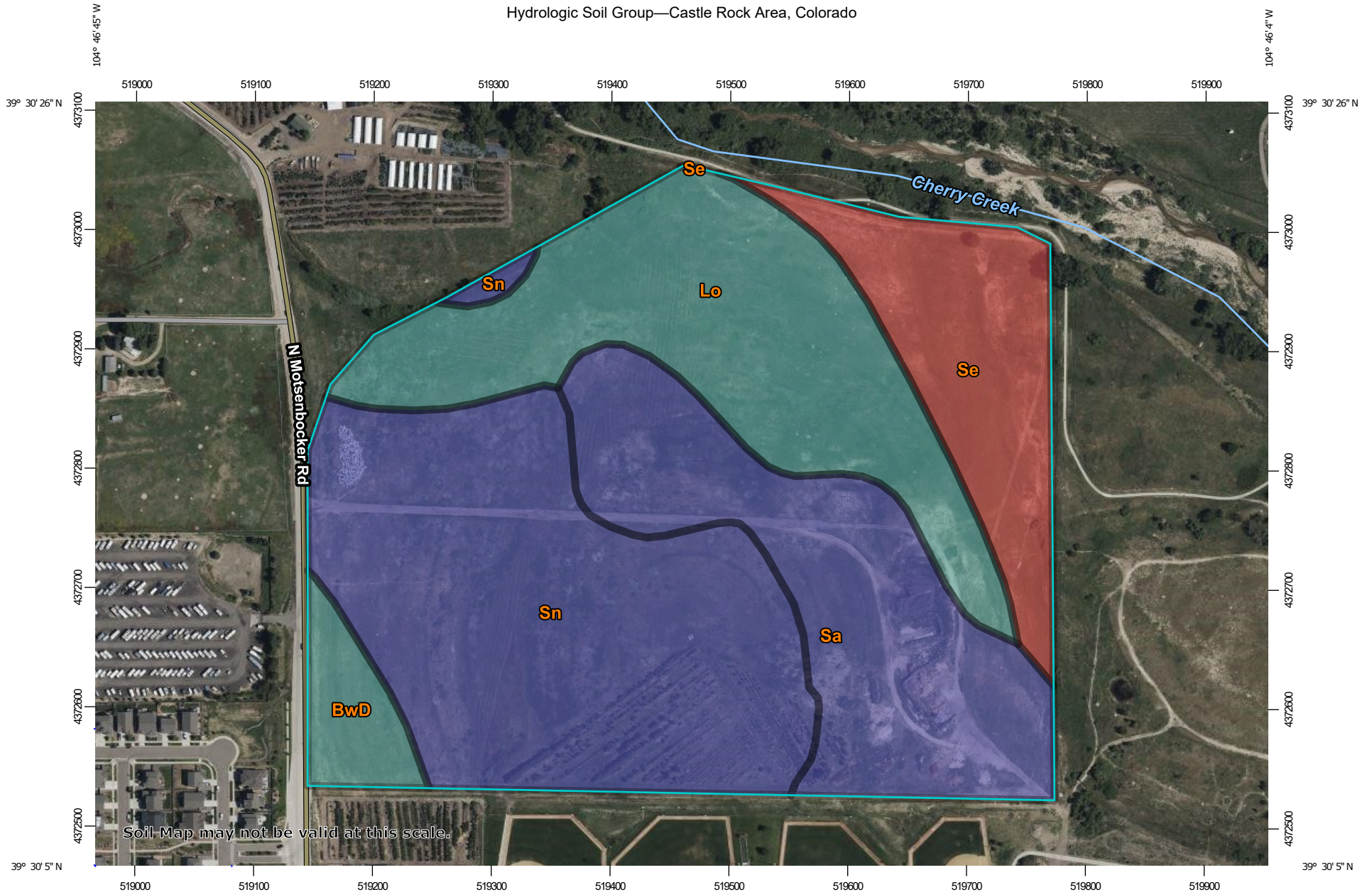
The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 6/16/2023 at 4:40 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.


This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.

Hydrologic Soil Group—Castle Rock Area, Colorado



## MAP LEGEND

### Area of Interest (AOI)









 Area of Interest (AOI)

### Soils

#### Soil Rating Polygons





 A  
 A/D  
 B  
 B/D  
 C  
 C/D  
 D  
 Not rated or not available

#### Soil Rating Lines


 A  
 A/D  
 B  
 B/D  
 C  
 C/D  
 D  
 Not rated or not available

#### Soil Rating Points






 A  
 A/D  
 B  
 B/D

 C  
 C/D  
 D  
 Not rated or not available

### Water Features

 Streams and Canals

### Transportation

 Rails  
 Interstate Highways  
 US Routes  
 Major Roads  
 Local Roads

### Background

 Aerial Photography

## MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:20,000.

**Warning:** Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service  
 Web Soil Survey URL:  
 Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Castle Rock Area, Colorado  
 Survey Area Data: Version 17, Aug 29, 2024

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Mar 1, 2023—Sep 1, 2023

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

## Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
BwD	Buick-Satanta loams, 3 to 9 percent slopes	C	2.6	3.7%
Lo	Loamy alluvial land	C	18.0	24.9%
Sa	Sampson loam	B	16.0	22.2%
Se	Sandy wet alluvial land	D	9.4	13.1%
Sn	Satanta loam	B	26.0	36.1%
<b>Totals for Area of Interest</b>			<b>72.1</b>	<b>100.0%</b>

### Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

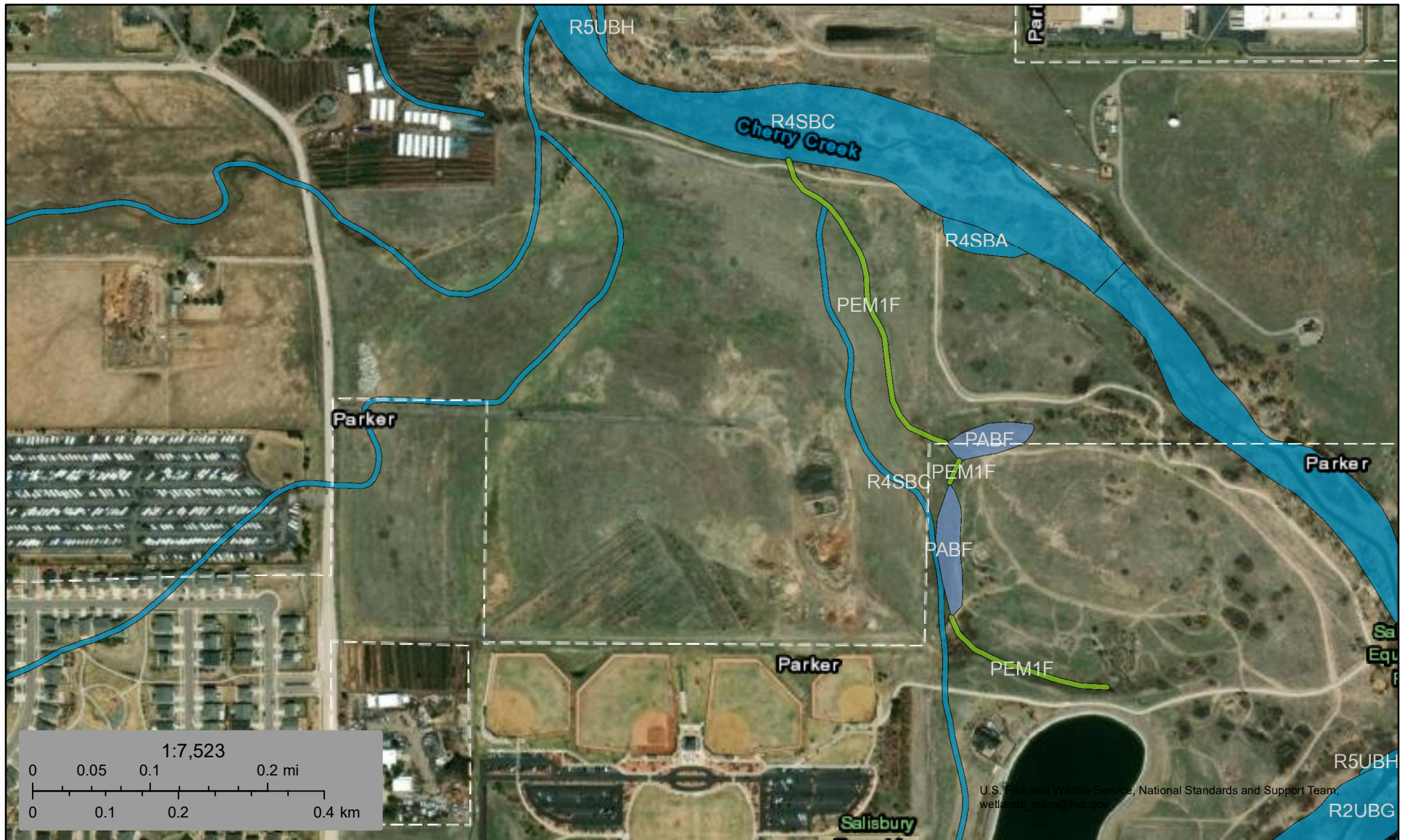
If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

## Rating Options

*Aggregation Method: Dominant Condition*

*Component Percent Cutoff: None Specified*

*Tie-break Rule: Higher*



November 14, 2024

### Wetlands

- |                                |                                   |          |
|--------------------------------|-----------------------------------|----------|
| Estuarine and Marine Deepwater | Freshwater Emergent Wetland       | Lake     |
| Estuarine and Marine Wetland   | Freshwater Forested/Shrub Wetland | Other    |
|                                | Freshwater Pond                   | Riverine |

This map is for general reference only. The US Fish and Wildlife Service is not responsible for the accuracy or currentness of the base data shown on this map. All wetlands related data should be used in accordance with the layer metadata found on the Wetlands Mapper web site.

# **APPENDIX B – HYDROLOGIC COMPUTATIONS**

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**JVA Incorporated**  
 1319 Spruce Street  
 Boulder, CO 80302  
 Ph: (303) 444 1951

**Project Information:**

Job Name: Salisbury Park North Phase 1  
 Job Number: 3752c  
 Date: 11/19/2024  
 Designed by: KAM  
 Municipality : Parker

**Runoff Calculations:**

Minor Design Storm: 5 year  
 Major Design Storm: 100 year

**Detention Calculations:**

Minor Storm Detention: EURV year  
 Major Storm Detention: 100 year  
 Detention Volume by: EURV (MHFD)

**Allowable Release Rates (if applicable):**

Max release rate 1 cfs / acre? Yes  
 Enter Offsite flows to bypass site (these will be added to the allowable release ra  
 Qminor = 0.00 cfs (bypass flows)  
 Q100 = 0.00 cfs (bypass flows)

**Rainfall Data Information:**

Enter City, Town, or County: Parker

Frequency of Design Event	One Hour Point Rainfall P1	
2 yr	0.99	in
5 yr	1.39	in
10 yr	1.64	in
100 yr	2.60	in

**Runoff Coefficient Calculations:**

Use MHFD Equations? Yes

**Intensity Duration Values:**

I-D-F

Please use latest NOAA Atlas 14 point rainfall values for Town of Parker in Hydrology calculations and provide reference to the data used in this report. Parker is in the process of updating the SDECM to reflect this in requirement.



**JVA Incorp.** Job Name: Salisbury Park North Phase 1  
 1319 Spruceb Number: 3752c  
 Boulder, CO Date: 11/19/24  
 Ph: (303) 44 By: KAM

Municipality: Parker

## Salisbury Park North Phase 1

### Historic Runoff Coefficient & Time of Concentration Calculations

Municipality: Parker  
 Impervious Values: MHFD  
 Runoff Coefficients: MHFD Formulae  
 Major Design Storm: 100  
 Minor Design Storm: 5

Basin Design Data																										
Basin Name	Soil Type	Design Point	I (%) =		Area (sf)	Area (sf)	A <sub>Total</sub> (sf)	A <sub>Total</sub> (ac)	Imp (%)	Runoff Coefficients (MHFD Formulae Table 6-5)				Initial Overland Time (t <sub>i</sub> ) MHFD Eq 6-3			Channelized Travel Time (t <sub>c</sub> ) MHFD Eq 6-4					t <sub>c</sub> Comp	Regional Check (t <sub>regional</sub> ) MHFD Eq 6-5			t <sub>c</sub> Final
			5%	95%						C2	C5	C10	C100	Length (ft)	Slope (%)	t <sub>i</sub> (min)	Length (ft)	Slope (%)	Type of Land Surface	K	Velocity (fps)		t <sub>c</sub> (min)	Time of Conc t <sub>i</sub> + t <sub>c</sub> = t <sub>c</sub>	Channelized Length (ft)	
H1	C/D	1	759,288	5,897	765,185	17.57	5.7%	0.03	0.08	0.17	0.51	500	1.4%	37.8			Paved areas & shallow paved	20	0.0	0.0	37.8	0	0.000	N/A	37.8	
H2	C/D	2	1,951,339		1,951,339	44.80	5.0%	0.03	0.08	0.17	0.50	500	1.0%	42.6			Paved areas & shallow paved	20	0.0	0.0	42.6	0	0.000	N/A	42.6	
H3	C/D	3	35,811	970	36,780	0.84	7.4%	0.04	0.10	0.19	0.51	19	25.0%	2.7	163	1.8%	Paved areas & shallow paved	20	2.7	1.0	3.8	163	0.018	26.8	5.0	
H4	C/D	4	516304.11	22422.37	538,726	12.37	8.7%	0.05	0.11	0.20	0.52	438	1.4%	34.1	570	0.5%	Grassed waterway	15	1.1	9.0	43.0	570	0.005	37.7	37.7	
TOTAL SITE			3,262,742	29,289	3,292,031	75.57	5.8%	0.03	0.08	0.17	0.51															

$$I = (28.5 P1) / ((10 + TC) 0.786)$$

Basin Name	Design Point	Time of Conc (tc)	Runoff Coeff's				Rainfall Intensities (in/hr)				Area		Flow Rates (cfs)			
			C2	C5	C10	C100	2	5	10	100	A <sub>Total</sub> (sf)	A <sub>Total</sub> (ac)	Q2	Q5	Q10	Q100
H1	1	37.8	0.03	0.08	0.17	0.51	1.35	1.90	2.24	3.55	765,185	17.57	0.79	2.71	6.83	31.61
H2	2	42.6	0.03	0.08	0.17	0.50	1.25	1.76	2.08	3.29	1,951,339	44.80	1.62	5.97	15.69	74.37
H3	3	5.0	0.04	0.10	0.19	0.51	3.36	4.71	5.56	8.82	36,780	0.84	0.13	0.38	0.87	3.83
H4	4	37.7	0.05	0.11	0.20	0.52	1.35	1.90	2.24	3.55	538,726	12.37	0.91	2.50	5.44	22.85
TOTAL SITE											3,292,031	75.57	3.45	11.56	28.84	132.66



**JVA Incorporated**  
 1319 Spruce Street  
 Boulder, CO 80302  
 Ph: (303) 444 1951

Job Name: Salisbury Park North Phase 1  
 Job Number: 3752c  
 Date: 11/19/24  
 By: KAM

**Salisbury Park North Phase 1**  
**Composite Runoff Coefficient Calculations**

Municipality: Parker  
 Impervious Values: MHFD  
 Runoff Coefficients: MHFD Formulae

Basin Design Data											Runoff Coefficients (MHFD Formulae Table 6-5)					
Basin Name	Soil Type	Design Point	I (%) =							A <sub>Total</sub> (sf)	A <sub>Total</sub> (ac)	Imp (%)	C2	C5	C10	C100
			95%	95%	95%	20%	60%	5%								
			Streets Paved	Concrete Drives/Walks	Roof	Landscaping	Artificial Turf (Sports Fields)	Undisturbed Native								
A1	C/D	1		28,471	3,467	11,513			43,451	1.00	75.1%	0.61	0.65	0.68	0.79	
A2	C/D	2		16,852		118,288			135,140	3.10	29.4%	0.21	0.27	0.35	0.60	
A3	C/D	3		41,552		191,216			232,768	5.34	33.4%	0.24	0.31	0.38	0.62	
A4	C/D	4	26,219	12,784		28,084			67,088	1.54	63.6%	0.50	0.55	0.60	0.74	
A5	C/D	5	14,455						14,455	0.33	95.0%	0.79	0.81	0.83	0.87	
A6	C/D	6	14,203						14,203	0.33	95.0%	0.79	0.81	0.83	0.87	
A7	C/D	7	34,562	2,630		63,598			100,790	2.31	47.7%	0.36	0.42	0.48	0.68	
C1	C/D	8	31,860	7,024		64,739			103,623	2.38	48.1%	0.37	0.43	0.49	0.68	
C2	C/D	9	30,714	5,552		6,425			42,691	0.98	83.7%	0.68	0.72	0.75	0.83	
C3	C/D	10		22,578		152,490			175,068	4.02	29.7%	0.21	0.28	0.35	0.61	
C4	C/D	11		28,629		146,505			175,134	4.02	32.3%	0.23	0.30	0.37	0.62	
D1	C/D	12		27,166		30,105	217,308		274,579	6.30	59.1%	0.46	0.52	0.57	0.73	
D2	C/D	13				40,653		20,327	60,980	1.40	15.0%	0.10	0.16	0.24	0.55	
E1	C/D	14	31,290	14,149		38,103			83,543	1.92	60.8%	0.48	0.53	0.58	0.73	
ALT 1	C/D	15		17,719	6,765	19,858			44,342	1.02	61.4%	0.48	0.54	0.58	0.74	
OS1	C/D	16				60,712		64,360	125,072	2.87	12.3%	0.08	0.14	0.22	0.53	
TOTAL SITE			183,303	225,104	10,232	972,291	217,308	84,686	1,692,924	38.86	42.9%	0.33	0.38	0.45	0.66	



**JVA Incorporated**  
 1319 Spruce Street  
 Boulder, CO 80302  
 Ph: (303) 444 1951

Job Name: Salisbury Park North Phase 1  
 Job Number: 3752c  
 Date: 11/19/24  
 By: KAM

Municipality: Parker

## Salisbury Park North Phase 1 Time of Concentration Calculations

Municipality: Parker  
 Impervious Values: MHFD  
 Runoff Coefficients: MHFD Formulae

Sub-Basin Data				Initial Overland Time (t <sub>i</sub> ) MHFD Eq 6-3			Channelized Travel Time (t <sub>c</sub> ) MHFD Eq 6-4						t <sub>c</sub> Comp	Regional Check (t <sub>regional</sub> ) MHFD Eq 6-5			t <sub>c</sub> Final
Basin Name	Design Point	A <sub>Total</sub> (ac)	C5	Length (ft)	Slope (%)	t <sub>i</sub> (min)	Length (ft)	Slope (%)	Type of Land Surface	C <sub>v</sub>	Velocity (fps)	t <sub>c</sub> (min)	Time of Conc t <sub>i</sub> + t <sub>c</sub> = t <sub>c</sub>	Channelized Length (ft)	Channelized Slope (ft/ft)	t <sub>regional</sub>	t <sub>c</sub> or t <sub>regional</sub>
A1	1	1.00	0.65	21	2.00%	3.0			Paved areas & shallow paved swales	20	0.0	0.0	3.0	0	0.000	N/A	5.0
A2	2	3.10	0.27	110	1.00%	15.9	583	0.50%	Grassed waterway	15	1.1	9.2	25.0	583	0.005	31.5	25.0
A3	3	5.34	0.31	300	1.20%	23.7	442	0.60%	Grassed waterway	15	1.2	6.3	30.0	442	0.006	27.3	27.3
A4	4	1.54	0.55	106	2.40%	7.7	31	2.40%	Paved areas & shallow paved swales	20	3.1	0.2	7.9	31	0.024	15.4	7.9
A5	5	0.33	0.81	12	2.00%	1.5	1136	1.40%	Paved areas & shallow paved swales	20	2.4	8.0	9.5	1136	0.014	17.0	9.5
A6	6	0.33	0.81	12	2.00%	1.5	1152	1.40%	Paved areas & shallow paved swales	20	2.4	8.1	9.6	1152	0.014	17.1	9.6
A7	7	2.31	0.42	221	2.20%	14.2	304	0.50%	Paved areas & shallow paved swales	20	1.4	3.6	17.8	304	0.005	22.5	17.8
C1	8	2.38	0.43	118	2.10%	10.5	554	0.70%	Paved areas & shallow paved swales	20	1.7	5.5	16.0	554	0.007	24.8	16.0
C2	9	0.98	0.72	76	1.60%	5.2	201	0.50%	Paved areas & shallow paved swales	20	1.4	2.4	7.6	201	0.005	14.1	7.6
C3	10	4.02	0.28	120	1.00%	16.5	795	0.40%	Grassed waterway	15	0.9	14.0	30.5	795	0.004	36.9	30.5
C4	11	4.02	0.30	143	1.00%	17.6	685	0.50%	Grassed waterway	15	1.1	10.8	28.3	685	0.005	32.5	28.3
D1	12	6.30	0.52	308	0.50%	23.7			Paved areas & shallow paved swales	20	0.0	0.0	23.7	0	0.000	N/A	23.7
D2	13	1.40	0.16	275	1.90%	23.1			Paved areas & shallow paved swales	20	0.0	0.0	23.1	0	0.000	N/A	23.1
E1	14	1.92	0.53	39	2.70%	4.7	661	1.90%	Paved areas & shallow paved swales	20	2.8	4.0	8.7	661	0.019	20.2	8.7
ALT 1	15	1.02	0.54	88	1.90%	7.8			Paved areas & shallow paved swales	20	0.0	0.0	7.8	0	0.000	N/A	7.8
OS1	16	2.87	0.14	287	2.00%	23.8	186	1.10%	Paved areas & shallow paved swales	20	2.1	1.5	25.3	186	0.011	26.7	25.3



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Job Name: Salisbury Park North Phase 1  
 Job Number: 3752c  
 Date: 11/19/24  
 By: KAM

**Salisbury Park North Phase 1**

**Developed Storm Runoff Calculations**

Design Storm :

**100 Year**

Point Hour Rainfall (P<sub>1</sub>) : **2.60**

$I = (28.5 P_1) / ((10 + TC)^{0.786})$

Basin Name	Design Point	Direct Runoff						Total Runoff				Inlets			Pipe					Pipe/Swale Travel Time				Notes					
		Area (ac)	C/100	t <sub>c</sub> (min)	C*A (ac)	I (in/hr)	Q (cfs)	Total t <sub>c</sub> (min)	ΣC*A (ac)	I (in/hr)	Q (cfs)	Inlet Type	Q intercepted	Q carryover	Q bypass	Pipe Size (in) or equivalent	Pipe Material	Slope (%)	Pipe Flow (cfs)	Max Pipe Capacity (cfs)	Length (ft)	Velocity (fps)	t <sub>t</sub> (min)		Total Time (min)				
A1	1	1.00	0.79	5.0	0.79	8.81	6.95	5.00	0.79	8.82	6.96	Perforated Drains	6.96	0.00	0.00	12 in	PVC	0.5%	7.0	3.5	487	4.2	1.95	6.95	Basin A1				
A2	2	3.10	0.60	25.0	1.87	4.52	8.47	25.04	1.87	4.53	8.48														Basin A2				
TOTAL TO DP2								25.04	2.66	4.53	12.06	Flared End Section	12.06	0.00	0.00	18 in	RCP	0.4%	12.1	7.1	180	3.8	0.80	25.84	Basin A1 + A2				
A3	3	5.34	0.62	27.3	3.32	4.31	14.29	27.28	3.32	4.31	14.30														Basin A3				
TOTAL TO DP3								27.28	5.98	4.31	25.78	Flared End Section	25.78	0.00	0.00	24 in	RCP	0.5%	25.8	17.2	298	5.1	0.98	28.25	DP2 + Basin A3				
A4	4	1.54	0.74	7.9	1.15	7.68	8.80	7.87	1.15	7.68	8.81	Area Inlet	8.81	0.00	0.00	18 in	RCP	0.5%	8.8	8.0	14	4.2	0.06	7.93	Basin A4				
A5	5	0.33	0.87	9.5	0.29	7.18	2.08	9.47	0.29	7.19	2.08														Basin A5				
TOTAL TO DP5								9.47	1.44	7.19	10.32	Combination Inlet	10.32	0.00	0.00	18 in	RCP	0.5%	10.3	8.0	24	4.2	0.10	9.56	Basin A4 + A5				
A6	6	0.33	0.87	9.6	0.28	7.15	2.03	9.58	0.28	7.15	2.03														Basin A6				
TOTAL TO DP6								9.58	1.72	7.15	12.30	Combination Inlet	12.30	0.00	0.00	18 in	RCP	0.5%	12.3	8.0	11	4.2	0.04	9.62	DP5 + A6				
A7	7	2.31	0.68	17.8	1.57	5.43	8.53	17.76	1.57	5.44	8.54	Sheet Flow to Pond	8.54	0.00	0.00										Basin A7				
C1	8	2.38	0.68	16.0	1.62	5.72	9.27	15.98	1.62	5.73	9.28	Combination Inlet	9.28	0.00	0.00	18 in	RCP	0.5%	9.3	8.0	273	4.2	1.08	17.06	Basin C1				
C2	9	0.98	0.83	7.6	0.81	7.77	6.29	7.60	0.81	7.78	6.30														Basin C2				
TOTAL TO DP9								17.06	2.43	5.55	13.48	Combination Inlet	13.48	0.00	0.00	18 in	RCP	0.5%	13.5	8.0	107	4.2	0.42	17.49	Basin C1 + C2				
C3	10	4.02	0.61	30.5	2.43	4.03	9.80	30.50	2.43	4.04	9.83														Basin C3				
TOTAL TO DP10								30.50	4.86	4.04	19.64	Flared End Section	19.64	0.00	0.00	24 in	RCP	0.5%	19.6	17.2	123	5.1	0.40	30.90	DP9 + Basin C3				
C4	11	4.02	0.62	28.3	2.48	4.21	10.43	28.35	2.48	4.22	10.44														Basin C4				
TOTAL TO DP11								30.90	7.34	4.01	29.42																		DP10 + Basin C4
D1	12	6.30	0.73	23.7	4.57	4.67	21.36	23.66	4.57	4.67	21.37	Underdrain	21.37	0.00	0.00	24 in	RCP	0.5%	21.4	17.2	118	5.1	0.39	24.04	Basin D1				
D2	13	1.40	0.55	23.1	0.76	4.72	3.60	23.14	0.76	4.73	3.61	Sheet Flow to Pond	3.61	0.00	0.00										Basin D2				
E1	14	1.92	0.73	8.7	1.41	7.42	10.43	8.68	1.41	7.42	10.43	Sheet Flow to Pond	10.43	0.00	0.00										Basin E1				
ALT 1	15	1.02	0.74	7.8	0.75	7.69	5.76	7.84	0.75	7.70	5.76	Area Inlet	5.76	0.00	0.00	8 in	PVC	2.0%	5.8	2.4	105	6.3	0.28	8.11	Basin ALT 1				
OS1	16	2.87	0.53	25.3	1.53	4.50	6.90	25.27	1.53	4.50	6.91	Flared End Section	6.91	0.00	0.00	18 in	RCP	2.4%	6.9	17.4	110	8.6	0.21	25.48	Basin OS1				



JVA Inco Name: Salisbury Park North Phase 1  
 1319 Spr Number: 3752c  
 Boulder, CO Date: 11/19/24  
 Ph: (303) By: KAM

**Salisbury Park North Phase 1      Developed Storm Runoff Calculations**

Design Storm : **5 Year** fall (P<sub>1</sub>) : **1.39**      I = (28.5 P<sub>1</sub>) / ((10 + TC)<sup>0.786</sup>)

Basin Name	Design Point	Direct Runoff			Total Runoff				Inlets				Pipe			Pipe/Swale Travel Time				Notes			
		Area (ac)	C5	tc (min)	Total tc (min)	ΣC*A (ac)	I (in/hr)	Q (cfs)	Inlet Type	Q intercepted	Q carryover	Q bypass	Pipe Size (in) or equivalent	Pipe Material	Slope (%)	Pipe Flow (cfs)	Max Pipe Capacity (cfs)	Length (ft)	Velocity (fps)		tt (min)	Total Time (min)	
A1	1	1.00	0.65	5.00	5.00	0.65	4.71	3.04	Perforated Drains	3.04	0.00	0.00	12 in	PVC	0.5%	3.0	3.5	487	4.7	1.74	6.74	Basin A1	
A2	2	3.10	0.27	25.04	25.04	0.85	2.42	2.06														Basin A2	
TOTAL TO DP2					25.04	1.50	2.42	3.62	Flared End Section	3.62	0.00	0.00	18 in	RCP	0.4%	3.6	7.1	180	3.8	0.80	25.84	Basin A1 + A2	
A3	3	5.34	0.31	27.28	27.28	1.64	2.31	3.78														Basin A3	
TOTAL TO DP3					27.28	3.14	2.31	7.23	Flared End Section	7.23	0.00	0.00	24 in	RCP	0.5%	7.2	17.2	298	4.9	1.02	28.30	DP2 + Basin A3	
A4	4	1.54	0.55	7.87	7.87	0.85	4.11	3.50	Area Inlet	3.50	0.00	0.00	18 in	RCP	0.5%	3.5	8.0	14	4.1	0.06	7.93	Basin A4	
A5	5	0.33	0.81	9.47	9.47	0.27	3.84	1.03														Basin A5	
TOTAL TO DP5					9.47	1.12	3.84	4.31	Combination Inlet	4.31	0.00	0.00	18 in	RCP	0.5%	4.3	8.0	24	4.3	0.09	9.56	Basin A4 + A5	
A6	6	0.33	0.81	9.58	9.58	0.26	3.82	1.01														Basin A6	
TOTAL TO DP6					9.58	1.38	3.82	5.29	Combination Inlet	5.29	0.00	0.00	18 in	RCP	0.5%	5.3	8.0	11	4.5	0.04	9.62	DP5 + A6	
A7	7	2.31	0.42	17.76	17.76	0.98	2.91	2.85	Sheet Flow to Pond	2.85	0.00	0.00										Basin A7	
C1	8	2.38	0.43	15.98	15.98	1.02	3.06	3.11	Combination Inlet	3.11	0.00	0.00	18 in	RCP	0.5%	3.1	8.0	273	3.9	1.16	17.14	Basin C1	
C2	9	0.98	0.72	7.60	7.60	0.70	4.16	2.92														Basin C2	
TOTAL TO DP9					17.14	1.72	2.96	5.09	Combination Inlet	5.09	0.00	0.00	18 in	RCP	0.5%	5.1	8.0	107	4.5	0.40	17.54	Basin C1 + C2	
C3	10	4.02	0.28	30.50	30.50	1.11	2.16	2.40														Basin C3	
TOTAL TO DP10					30.50	2.83	2.16	6.12	Flared End Section	6.12	0.00	0.00	24 in	RCP	0.5%	6.1	17.2	123	4.6	0.44	30.94	DP9 + Basin C3	
C4	11	4.02	0.30	28.35	28.35	1.20	2.25	2.70														Basin C4	
TOTAL TO DP11					30.94	4.03	2.14	8.63															DP10 + Basin C4
D1	12	6.30	0.52	23.66	23.66	3.26	2.50	8.13	Underdrain	8.13	0.00	0.00	24 in	RCP	0.5%	8.1	17.2	118	5.0	0.39	24.05	Basin D1	
D2	13	1.40	0.16	23.14	23.14	0.22	2.53	0.56	Sheet Flow to Pond	0.56	0.00	0.00										Basin D2	
E1	14	1.92	0.53	8.68	8.68	1.02	3.97	4.04	Sheet Flow to Pond	4.04	0.00	0.00										Basin E1	
ALT 1	15	1.02	0.54	7.84	7.84	0.55	4.11	2.24	Area Inlet	2.24	0.00	0.00	8 in	PVC	2.0%	2.2	2.4	105	6.3	0.28	8.11	Basin ALT 1	
OS1	16	2.87	0.14	25.27	25.27	0.39	2.41	0.93	Flared End Section	0.93	0.00	0.00	18 in	RCP	2.4%	0.9	17.4	110	4.7	0.39	25.65	Basin OS1	

## **APPENDIX C – HYDRAULIC COMPUTATIONS**

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Per Section 6.5.4 of the SDECM, please provide riprap sizing calculations for all inlet/outlet protection in accordance with Chapter 9 of the USDCM-Volume-2.

## SWALE CALCULATIONS

# Channel Report

## SWALE DP2

### User-defined

Invert Elev (ft) = 47.44  
Slope (%) = 0.50  
N-Value = 0.025

### Calculations

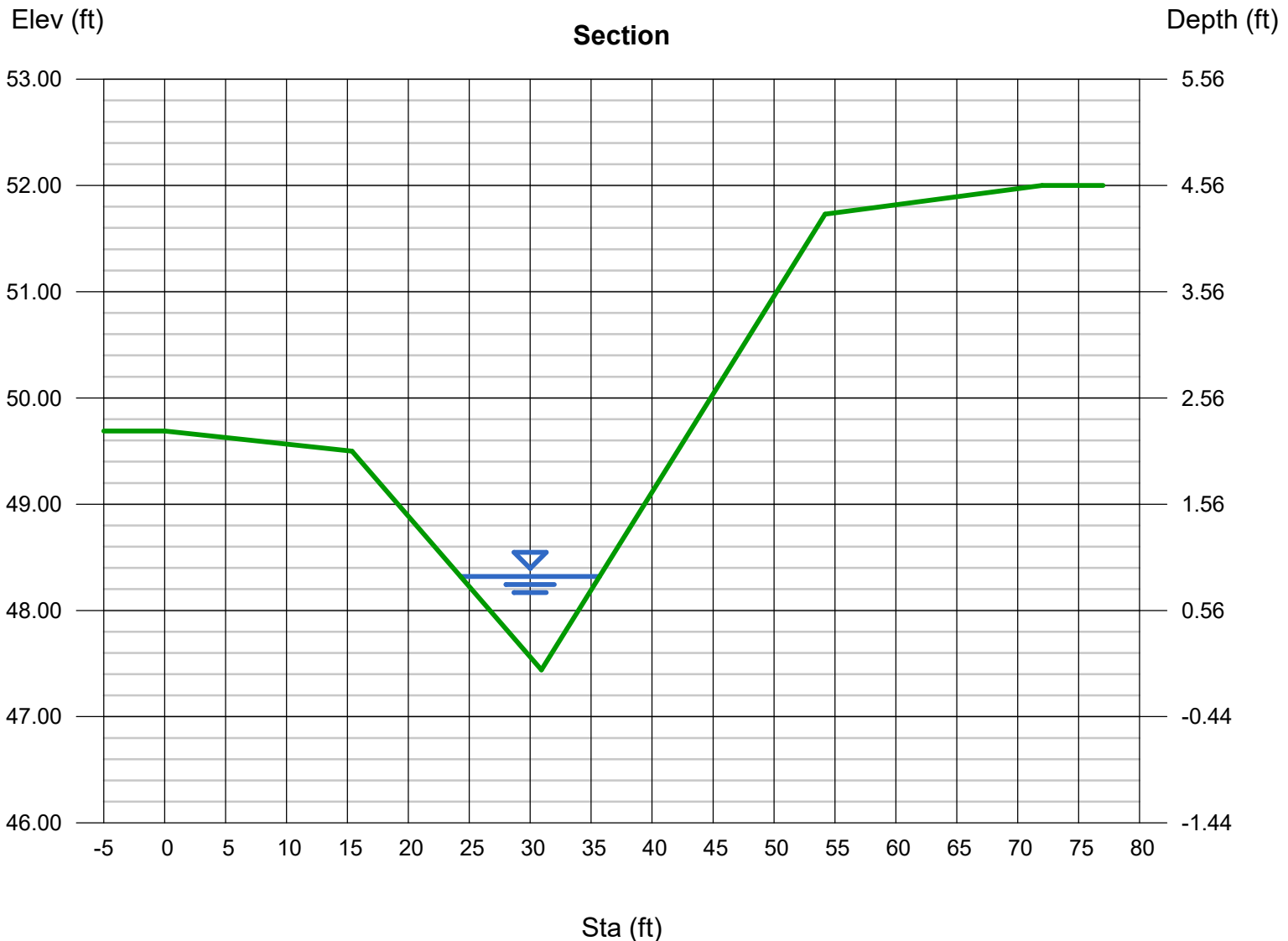
Compute by: Known Q  
Known Q (cfs) = 12.06

### Highlighted

Depth (ft) = 0.88  
Q (cfs) = 12.06  
Area (sqft) = 5.02  
Velocity (ft/s) = 2.40  
Wetted Perim (ft) = 11.55  
Crit Depth, Yc (ft) = 0.74  
Top Width (ft) = 11.41  
EGL (ft) = 0.97

### (Sta, El, n)-(Sta, El, n)...

(0.00, 49.69)-(15.38, 49.50, 0.025)-(30.92, 47.44, 0.025)-(54.20, 51.73, 0.025)-(72.00, 52.00, 0.025)



# Channel Report

## SWALE DP3

### User-defined

Invert Elev (ft) = 43.50  
Slope (%) = 0.50  
N-Value = 0.025

### Calculations

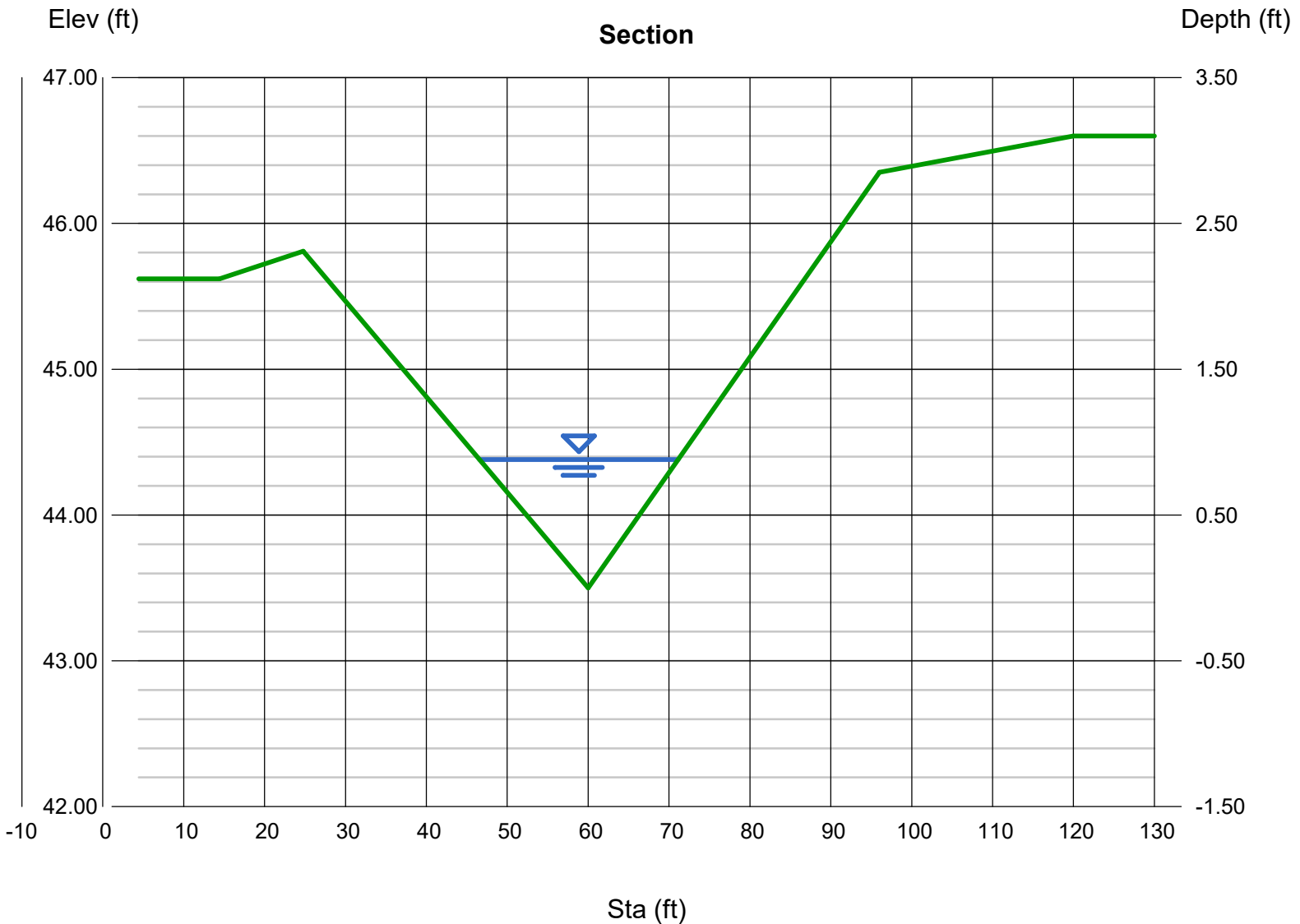
Compute by: Known Q  
Known Q (cfs) = 25.78

### Highlighted

Depth (ft) = 0.88  
Q (cfs) = 25.78  
Area (sqft) = 10.80  
Velocity (ft/s) = 2.39  
Wetted Perim (ft) = 24.60  
Crit Depth, Yc (ft) = 0.74  
Top Width (ft) = 24.54  
EGL (ft) = 0.97

### (Sta, El, n)-(Sta, El, n)...

( 14.45, 45.62)-(24.78, 45.81, 0.025)-(60.00, 43.50, 0.025)-(96.01, 46.35, 0.025)-(120.00, 46.60, 0.025)



# Channel Report

## SWALE DP4

### User-defined

Invert Elev (ft) = 42.59  
Slope (%) = 1.10  
N-Value = 0.025

### Highlighted

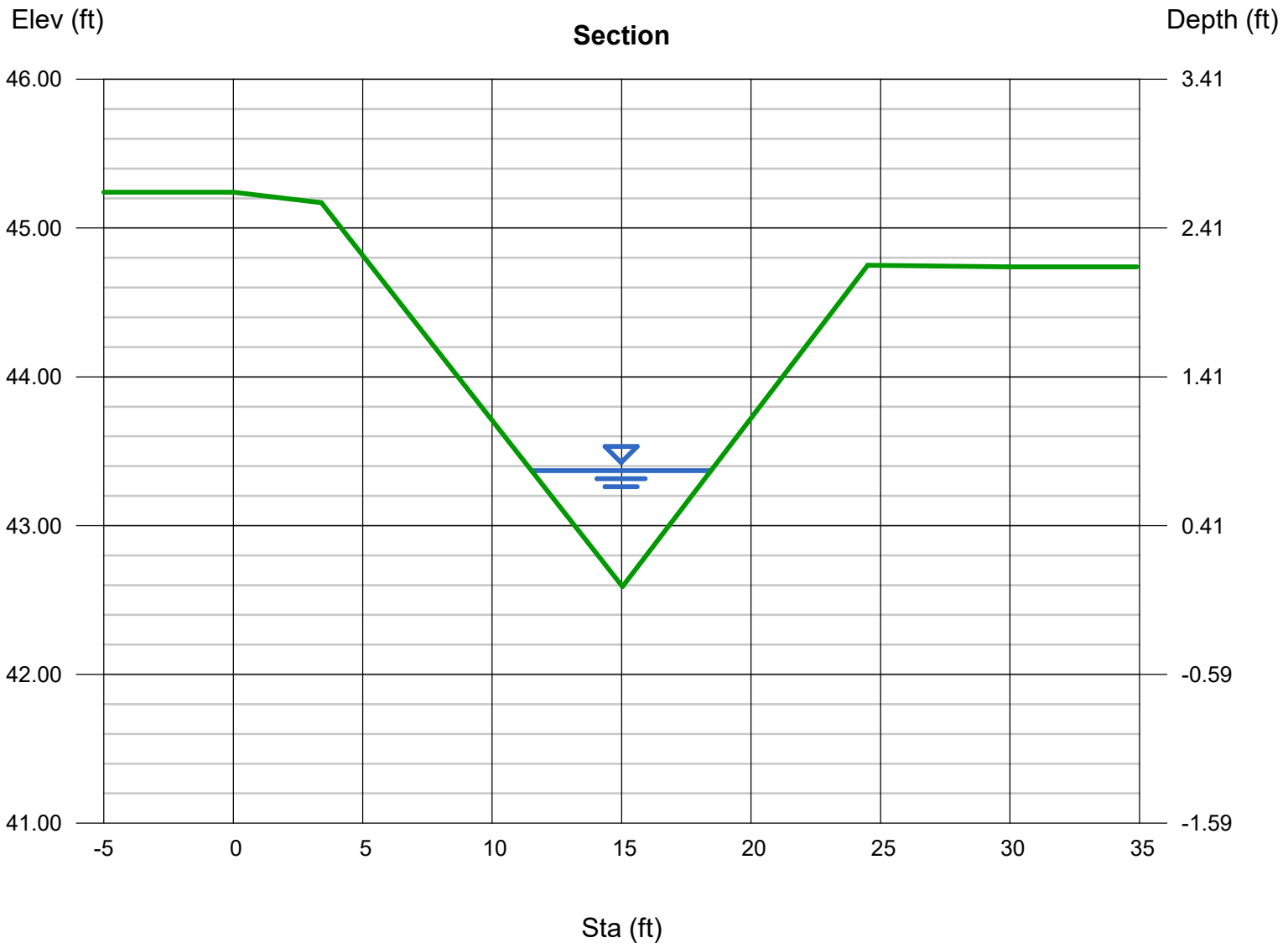
Depth (ft) = 0.78  
Q (cfs) = 8.810  
Area (sqft) = 2.70  
Velocity (ft/s) = 3.26  
Wetted Perim (ft) = 7.11  
Crit Depth, Yc (ft) = 0.76  
Top Width (ft) = 6.94  
EGL (ft) = 0.94

### Calculations

Compute by: Known Q  
Known Q (cfs) = 8.81

### (Sta, El, n)-(Sta, El, n)...

(0.00, 45.24)-(3.40, 45.17, 0.025)-(15.03, 42.59, 0.025)-(24.50, 44.75, 0.025)-(29.90, 44.74, 0.025)



# Channel Report

## SWALE DP10

### User-defined

Invert Elev (ft) = 47.25  
Slope (%) = 0.50  
N-Value = 0.025

### Highlighted

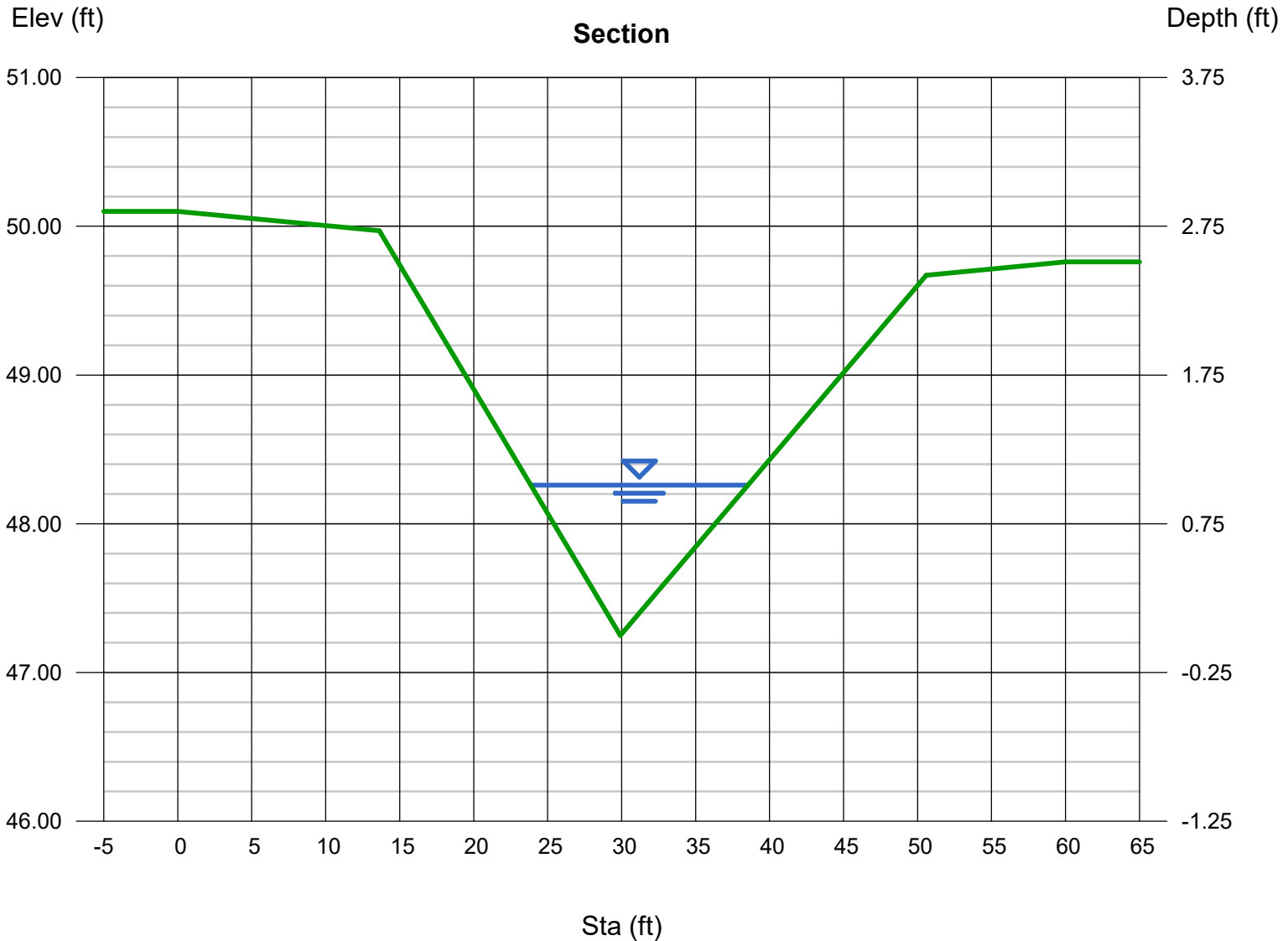
Depth (ft) = 1.01  
Q (cfs) = 19.64  
Area (sqft) = 7.41  
Velocity (ft/s) = 2.65  
Wetted Perim (ft) = 14.81  
Crit Depth, Yc (ft) = 0.86  
Top Width (ft) = 14.67  
EGL (ft) = 1.12

### Calculations

Compute by: Known Q  
Known Q (cfs) = 19.64

### (Sta, El, n)-(Sta, El, n)...

(0.00, 50.10)-(13.63, 49.97, 0.025)-(29.91, 47.25, 0.025)-(50.58, 49.67, 0.025)-(60.00, 49.76, 0.025)



## MHFD INLET CALCULATIONS

## INLET MANAGEMENT

Worksheet: Protected

INLET NAME	INLET A5	INLET A6	Inlet C1	INLET C2
Site Type (Urban or Rural)	URBAN	URBAN	URBAN	URBAN
Inlet Application (Street or Area)	STREET	STREET	STREET	STREET
Hydraulic Condition	On Grade	On Grade	In Sump	In Sump
Inlet Type	Denver No. 16 Combination	Denver No. 16 Combination	Denver No. 16 Combination	Denver No. 16 Combination

### USER-DEFINED INPUT

User-Defined Design Flows				
Minor $Q_{design}$ (cfs)	1.0	1.0	3.1	2.9
Major $Q_{design}$ (cfs)	2.1	2.0	9.3	6.3
Bypass (Carry-Over) Flow from Upstream <small>Inlets must be organized from upstream (left) to downstream (right) in order for bypass flows to be linked.</small>				
Receive Bypass Flow from:	No Bypass Flow Received	No Bypass Flow Received	No Bypass Flow Received	No Bypass Flow Received
Minor Bypass Flow Received, $Q_b$ (cfs)	0.0	0.0	0.0	0.0
Major Bypass Flow Received, $Q_b$ (cfs)	0.0	0.0	0.0	0.0
Watershed Characteristics				
Subcatchment Area (acres)				
Percent Impervious				
NRCS Soil Type				
Watershed Profile				
Overland Slope (ft/ft)				
Overland Length (ft)				
Channel Slope (ft/ft)				
Channel Length (ft)				
Minor Storm Rainfall Input				
Design Storm Return Period, $T_r$ (years)				
One-Hour Precipitation, $P_1$ (inches)				
Major Storm Rainfall Input				
Design Storm Return Period, $T_r$ (years)				
One-Hour Precipitation, $P_1$ (inches)				

### CALCULATED OUTPUT

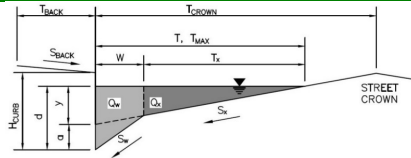
Minor Total Design Peak Flow, $Q$ (cfs)	1.0	1.0	3.1	2.9
Major Total Design Peak Flow, $Q$ (cfs)	2.1	2.0	9.3	6.3
Minor Flow Bypassed Downstream, $Q_b$ (cfs)	0.0	0.0	N/A	N/A
Major Flow Bypassed Downstream, $Q_b$ (cfs)	0.0	0.0	N/A	N/A

**ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)**

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: **Salisbury Park North - Phase 1**

Inlet ID: **INLET A5**



**Gutter Geometry:**

Maximum Allowable Width for Spread Behind Curb  
 Side Slope Behind Curb (leave blank for no conveyance credit behind curb)  
 Manning's Roughness Behind Curb (typically between 0.012 and 0.020)

$T_{BACK} = 0.0$  ft  
 $S_{BACK} =$  ft/ft  
 $n_{BACK} = 0.012$

Height of Curb at Gutter Flow Line  
 Distance from Curb Face to Street Crown  
 Gutter Width  
 Street Transverse Slope  
 Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)  
 Street Longitudinal Slope - Enter 0 for sump condition  
 Manning's Roughness for Street Section (typically between 0.012 and 0.020)

$H_{CURB} = 6.00$  inches  
 $T_{CROWN} = 13.0$  ft  
 $W = 2.00$  ft  
 $S_x = 0.020$  ft/ft  
 $S_w = 0.083$  ft/ft  
 $S_o = 0.010$  ft/ft  
 $n_{STREET} = 0.012$

Per the Town of Parker SDECM Section 6.3.1 for Street Drainage, use Mannings n for street=0.016 (TYP)

Max. Allowable Spread for Minor & Major Storm  
 Max. Allowable Depth at Gutter Flowline for Minor & Major Storm  
 Allow Flow Depth at Street Crown (check box for yes, leave blank for no)

	Minor Storm	Major Storm
$T_{MAX}$	13.0	13.0
$d_{MAX}$	6.0	6.0

inches

MINOR STORM Allowable Capacity is based on Spread Criterion  
 MAJOR STORM Allowable Capacity is based on Spread Criterion

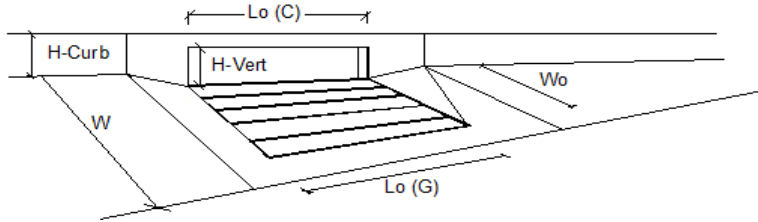
	Minor Storm	Major Storm
$Q_{allow}$	7.6	7.6

cfs

Minor storm max. allowable capacity GOOD - greater than the design peak flow of 1.03 cfs on sheet 'Inlet Management'  
 Major storm max. allowable capacity GOOD - greater than the design peak flow of 2.08 cfs on sheet 'Inlet Management'

## INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.03 (August 2023)



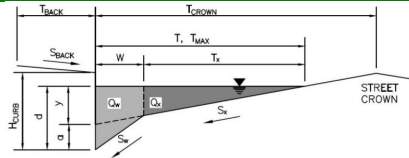
Design Information (Input)	MINOR		MAJOR	
Type of Inlet	Denver No. 16 Combination			
Local Depression (additional to continuous gutter depression 'a')	$a_{LOCAL} =$	2.0	2.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	3	3	
Length of a Single Unit Inlet (Grate or Curb Opening)	$L_o =$	3.00	3.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	$W_o =$	1.73	1.73	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	$C_r (G) =$	0.50	0.50	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	$C_r (C) =$	0.10	0.10	
Street Hydraulics: OK - $Q < \text{Allowable Street Capacity}$				
Total Inlet Interception Capacity	$Q =$	1.0	2.1	cfs
Total Inlet Carry-Over Flow (flow bypassing inlet)	$Q_b =$	0.0	0.0	cfs
Capture Percentage = $Q_i/Q_o$	$C\% =$	100	99	%

## ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

**Project: Salisbury Park North - Phase 1**

**Inlet ID: INLET A6**



**Gutter Geometry:**

Maximum Allowable Width for Spread Behind Curb  
 Side Slope Behind Curb (leave blank for no conveyance credit behind curb)  
 Manning's Roughness Behind Curb (typically between 0.012 and 0.020)

T <sub>BACK</sub> =	0.0	ft
S <sub>BACK</sub> =		ft/ft
n <sub>BACK</sub> =	0.015	

Height of Curb at Gutter Flow Line  
 Distance from Curb Face to Street Crown  
 Gutter Width  
 Street Transverse Slope  
 Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)  
 Street Longitudinal Slope - Enter 0 for sump condition  
 Manning's Roughness for Street Section (typically between 0.012 and 0.020)

H <sub>CURB</sub> =	6.00	inches
T <sub>CROWN</sub> =	13.0	ft
W =	2.00	ft
S <sub>X</sub> =	0.020	ft/ft
S <sub>W</sub> =	0.083	ft/ft
S <sub>O</sub> =	0.010	ft/ft
n <sub>STREET</sub> =	0.015	

Max. Allowable Spread for Minor & Major Storm  
 Max. Allowable Depth at Gutter Flowline for Minor & Major Storm  
 Allow Flow Depth at Street Crown (check box for yes, leave blank for no)

	Minor Storm	Major Storm	
T <sub>MAX</sub> =	13.0	13.0	ft
d <sub>MAX</sub> =	6.0	6.0	inches
	<input type="checkbox"/>	<input type="checkbox"/>	

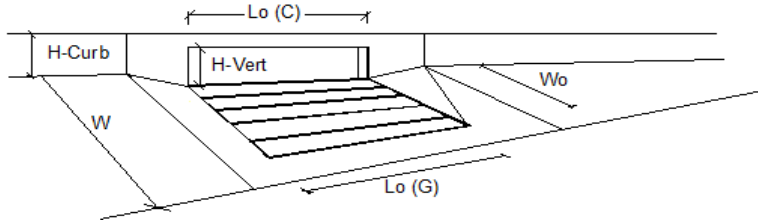
MINOR STORM Allowable Capacity is based on Spread Criterion  
 MAJOR STORM Allowable Capacity is based on Spread Criterion

	Minor Storm	Major Storm	
Q <sub>allow</sub> =	6.1	6.1	cfs

**Minor storm max. allowable capacity GOOD - greater than the design peak flow of 1.01 cfs on sheet 'Inlet Management'**  
**Major storm max. allowable capacity GOOD - greater than the design peak flow of 2.03 cfs on sheet 'Inlet Management'**

# INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.03 (August 2023)



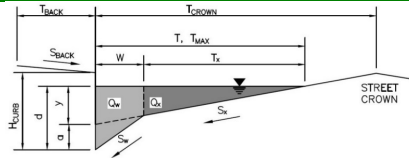
Design Information (Input)	MINOR		MAJOR	
Type of Inlet	Denver No. 16 Combination			
Local Depression (additional to continuous gutter depression 'a')	2.0	2.0	inches	
Total Number of Units in the Inlet (Grate or Curb Opening)	3	3		
Length of a Single Unit Inlet (Grate or Curb Opening)	3.00	3.00	ft	
Width of a Unit Grate (cannot be greater than W, Gutter Width)	1.73	1.73	ft	
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	0.50	0.50		
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	0.10	0.10		
Street Hydraulics: OK - $Q < \text{Allowable Street Capacity}$				
Total Inlet Interception Capacity	1.0	2.0	cfs	
Total Inlet Carry-Over Flow (flow bypassing inlet)	0.0	0.0	cfs	
Capture Percentage = $Q_i/Q_o$	100	100	%	

## ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

**Project:** Salisbury Park North - Phase 1

**Inlet ID:** Inlet C1



**Gutter Geometry:**

Maximum Allowable Width for Spread Behind Curb  
 Side Slope Behind Curb (leave blank for no conveyance credit behind curb)  
 Manning's Roughness Behind Curb (typically between 0.012 and 0.020)

$T_{BACK} = 10.0$  ft  
 $S_{BACK} = 0.052$  ft/ft  
 $n_{BACK} = 0.012$

Height of Curb at Gutter Flow Line  
 Distance from Curb Face to Street Crown  
 Gutter Width  
 Street Transverse Slope  
 Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)  
 Street Longitudinal Slope - Enter 0 for sump condition  
 Manning's Roughness for Street Section (typically between 0.012 and 0.020)

$H_{CURB} = 6.00$  inches  
 $T_{CROWN} = 158.5$  ft  
 $W = 2.00$  ft  
 $S_x = 0.005$  ft/ft  
 $S_w = 0.083$  ft/ft  
 $S_o = 0.000$  ft/ft  
 $n_{STREET} = 0.012$

**Warning 02**

Max. Allowable Spread for Minor & Major Storm  
 Max. Allowable Depth at Gutter Flowline for Minor & Major Storm  
 Check boxes are not applicable in SUMP conditions

	Minor Storm	Major Storm	
$T_{MAX} =$	158.5	158.5	ft
$d_{MAX} =$	8.0	8.0	inches
	<input type="checkbox"/>	<input type="checkbox"/>	

MINOR STORM Allowable Capacity is not applicable to Sump Condition  
MAJOR STORM Allowable Capacity is not applicable to Sump Condition

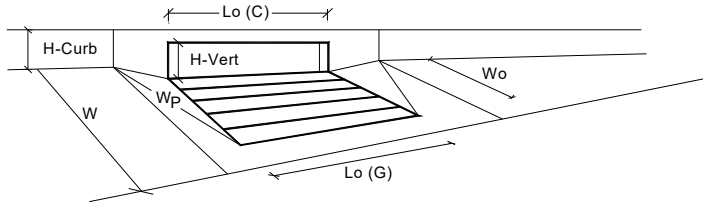
$Q_{allow} =$ 

Minor Storm	Major Storm
<b>SUMP</b>	<b>SUMP</b>

 cfs

# INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.03 (August 2023)



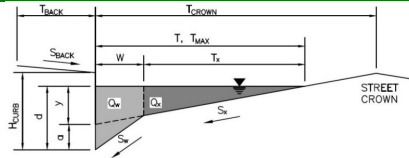
Design Information (Input)	MINOR	MAJOR	
Type of Inlet	Denver No. 16 Combination		
Local Depression (additional to continuous gutter depression 'a' from above)	2.00	2.00	inches
Number of Unit Inlets (Grate or Curb Opening)	2	2	
Water Depth at Flowline (outside of local depression)	8.0	8.0	inches
<b>Grate Information</b>			
Length of a Unit Grate	3.00	3.00	feet
Width of a Unit Grate	1.73	1.73	feet
Open Area Ratio for a Grate (typical values 0.15-0.90)	0.31	0.31	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	0.50	0.50	
Grate Weir Coefficient (typical value 2.15 - 3.60)	3.60	3.60	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	0.60	0.60	
<b>Curb Opening Information</b>			
Length of a Unit Curb Opening	3.00	3.00	feet
Height of Vertical Curb Opening in Inches	6.50	6.50	inches
Height of Curb Orifice Throat in Inches	5.25	5.25	inches
Angle of Throat	0.00	0.00	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	3.70	3.70	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	0.66	0.66	
<b>Low Head Performance Reduction (Calculated)</b>			
Depth for Grate Midwidth	0.69	0.69	ft
Depth for Curb Opening Weir Equation	0.50	0.50	ft
Grated Inlet Performance Reduction Factor for Long Inlets	0.94	0.94	
Curb Opening Performance Reduction Factor for Long Inlets	N/A	N/A	
Combination Inlet Performance Reduction Factor for Long Inlets	0.94	0.94	
<b>Total Inlet Interception Capacity (assumes clogged condition)</b>			
<b>Inlet Capacity IS GOOD for Minor and Major Storms (&gt;Q Peak)</b>	<b>15.3</b>	<b>15.3</b>	<b>cfs</b>
Q <sub>PEAK REQUIRED</sub>	3.1	9.3	cfs

## ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

**Project: Salisbury Park North - Phase 1**

**Inlet ID: INLET C2**



**Gutter Geometry:**

Maximum Allowable Width for Spread Behind Curb  
 Side Slope Behind Curb (leave blank for no conveyance credit behind curb)  
 Manning's Roughness Behind Curb (typically between 0.012 and 0.020)

$T_{BACK} = 26.2$  ft  
 $S_{BACK} = 0.012$  ft/ft  
 $n_{BACK} = 0.012$

Height of Curb at Gutter Flow Line  
 Distance from Curb Face to Street Crown  
 Gutter Width  
 Street Transverse Slope  
 Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)  
 Street Longitudinal Slope - Enter 0 for sump condition  
 Manning's Roughness for Street Section (typically between 0.012 and 0.020)

$H_{CURB} = 8.00$  inches  
 $T_{CROWN} = 159.3$  ft  
 $W = 2.00$  ft  
 $S_x = 0.005$  ft/ft  
 $S_w = 0.083$  ft/ft  
 $S_o = 0.000$  ft/ft  
 $n_{STREET} = 0.012$

Max. Allowable Spread for Minor & Major Storm  
 Max. Allowable Depth at Gutter Flowline for Minor & Major Storm  
 Check boxes are not applicable in SUMP conditions

	Minor Storm	Major Storm	
$T_{MAX} =$	159.0	159.0	ft
$d_{MAX} =$	6.0	6.0	inches
	<input type="checkbox"/>	<input type="checkbox"/>	

MINOR STORM Allowable Capacity is not applicable to Sump Condition  
MAJOR STORM Allowable Capacity is not applicable to Sump Condition

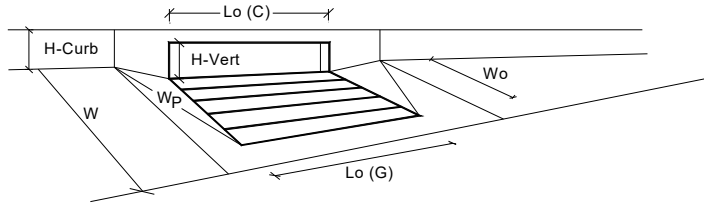
$Q_{allow} =$ 

Minor Storm	Major Storm
<b>SUMP</b>	<b>SUMP</b>

 cfs

# INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.03 (August 2023)



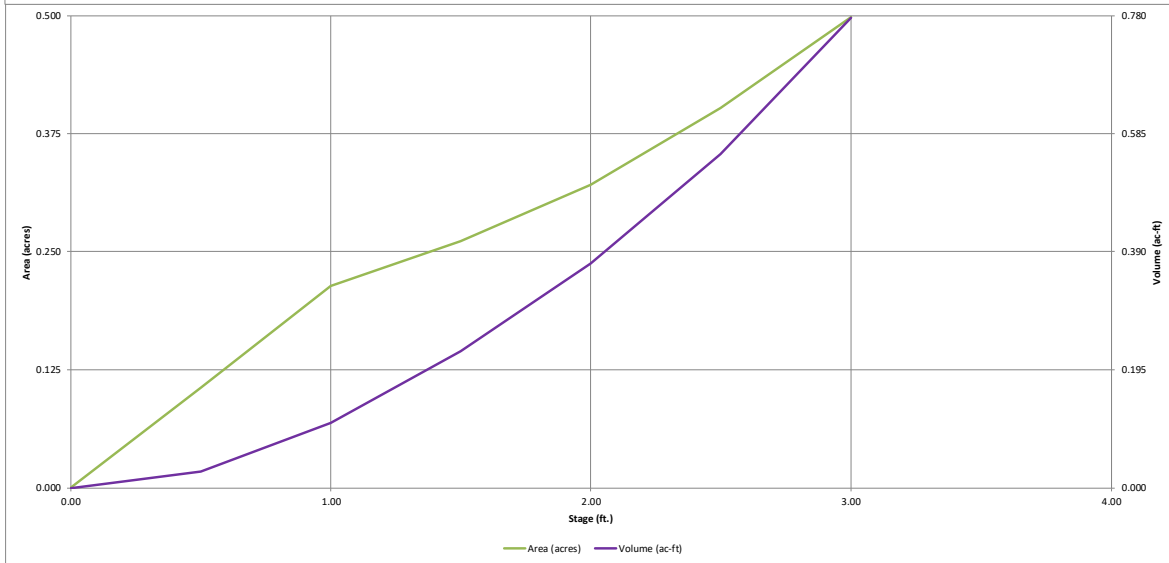
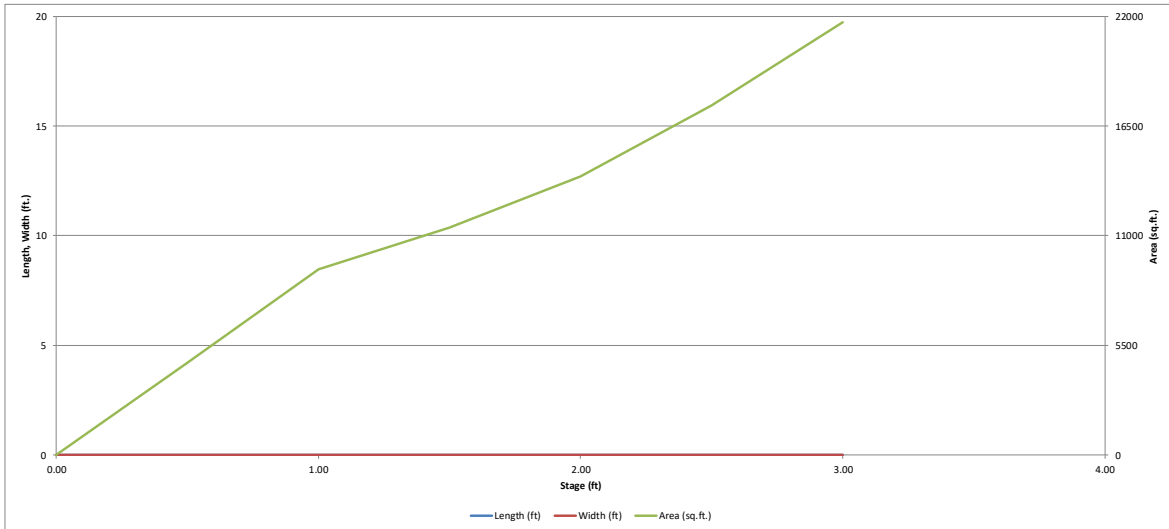
Design Information (Input)	MINOR	MAJOR	
Type of Inlet	Denver No. 16 Combination		
Local Depression (additional to continuous gutter depression 'a' from above)	2.00	2.00	inches
Number of Unit Inlets (Grate or Curb Opening)	2	2	
Water Depth at Flowline (outside of local depression)	6.0	6.0	inches
<b>Grate Information</b>			
Length of a Unit Grate	3.00	3.00	feet
Width of a Unit Grate	1.73	1.73	feet
Open Area Ratio for a Grate (typical values 0.15-0.90)	0.31	0.31	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	0.50	0.50	
Grate Weir Coefficient (typical value 2.15 - 3.60)	3.60	3.60	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	0.60	0.60	
<b>Curb Opening Information</b>			
Length of a Unit Curb Opening	3.00	3.00	feet
Height of Vertical Curb Opening in Inches	8.50	8.50	inches
Height of Curb Orifice Throat in Inches	5.25	5.25	inches
Angle of Throat	0.00	0.00	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	3.70	3.70	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	0.66	0.66	
<b>Low Head Performance Reduction (Calculated)</b>			
Depth for Grate Midwidth	0.52	0.52	ft
Depth for Curb Opening Weir Equation	0.33	0.33	ft
Grated Inlet Performance Reduction Factor for Long Inlets	0.71	0.71	
Curb Opening Performance Reduction Factor for Long Inlets	N/A	N/A	
Combination Inlet Performance Reduction Factor for Long Inlets	0.71	0.71	
<b>Total Inlet Interception Capacity (assumes clogged condition)</b>			
<b>Inlet Capacity IS GOOD for Minor and Major Storms (&gt;Q Peak)</b>	<b>7.7</b>	<b>7.7</b>	<b>cfs</b>
Q <sub>PEAK REQUIRED</sub>	2.9	6.3	cfs

## MHFD DETENTION POND CALCULATIONS



# DETENTION BASIN STAGE-STORAGE TABLE BUILDER

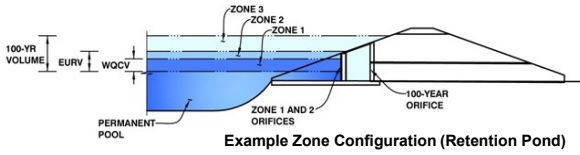
*MHFD-Detention, Version 4.06 (July 2022)*



# DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-*Detention*, Version 4.06 (July 2022)

**Project:** Salisbury Park North  
**Basin ID:** Pond A - Phase 1



	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	1.49	0.222	Orifice Plate
Zone 2 (10-year)	2.79	0.454	Weir (No Pipe)
Zone 3			
<b>Total (all zones)</b>		<b>0.676</b>	

**User Input:** Orifice at Underdrain Outlet (typically used to drain WQCV in a Filtration BMP)

Underdrain Orifice Invert Depth =  ft (distance below the filtration media surface)  
 Underdrain Orifice Diameter =  inches

**Calculated Parameters for Underdrain**  
 Underdrain Orifice Area =  ft<sup>2</sup>  
 Underdrain Orifice Centroid =  feet

**User Input:** Orifice Plate with one or more orifices or Elliptical Slot Weir (typically used to drain WQCV and/or EURV in a sedimentation BMP)

Centroid of Lowest Orifice =  0.00 ft (relative to basin bottom at Stage = 0 ft)  
 Depth at top of Zone using Orifice Plate =  1.50 ft (relative to basin bottom at Stage = 0 ft)  
 Orifice Plate: Orifice Vertical Spacing =  4.00 inches  
 Orifice Plate: Orifice Area per Row =  1.25 sq. inches (diameter = 1-1/4 inches)

**Calculated Parameters for Plate**  
 WQ Orifice Area per Row =  8.681E-03 ft<sup>2</sup>  
 Elliptical Half-Width =  N/A feet  
 Elliptical Slot Centroid =  N/A feet  
 Elliptical Slot Area =  N/A ft<sup>2</sup>

**User Input:** Stage and Total Area of Each Orifice Row (numbered from lowest to highest)

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	0.50	0.80	1.10	1.40			
Orifice Area (sq. inches)	1.25	1.25	1.25	1.25	1.25			

	Row 9 (optional)	Row 10 (optional)	Row 11 (optional)	Row 12 (optional)	Row 13 (optional)	Row 14 (optional)	Row 15 (optional)	Row 16 (optional)
Stage of Orifice Centroid (ft)								
Orifice Area (sq. inches)								

**User Input:** Vertical Orifice (Circular or Rectangular)

Invert of Vertical Orifice =  Not Selected  Not Selected ft (relative to basin bottom at Stage = 0 ft)  
 Depth at top of Zone using Vertical Orifice =  Not Selected  Not Selected ft (relative to basin bottom at Stage = 0 ft)  
 Vertical Orifice Diameter =  Not Selected  Not Selected inches

**Calculated Parameters for Vertical Orifice**  
 Vertical Orifice Area =  Not Selected  Not Selected ft<sup>2</sup>  
 Vertical Orifice Centroid =  Not Selected  Not Selected feet

**User Input:** Overflow Weir (Dropbox with Flat or Sloped Gate and Outlet Pipe OR Rectangular/Trapezoidal Weir and No Outlet Pipe)

Overflow Weir Front Edge Height, Ho =  Zone 2 Weir  Not Selected ft (relative to basin bottom at Stage = 0 ft)  
 Overflow Weir Bottom Length =  2.00 feet  
 Overflow Weir Side Slopes =  0.00 H:V  
 Horiz. Length of Weir Sides =  N/A feet  
 Overflow Gate Type =  N/A  
 Debris Clogging % =  N/A %

**Calculated Parameters for Overflow Weir**  
 Height of Gate Upper Edge, H<sub>g</sub> =  Zone 2 Weir  Not Selected feet  
 Overflow Weir Slope Length =  N/A feet  
 Gate Open Area / 100-yr Orifice Area =  N/A  
 Overflow Gate Open Area w/o Debris =  N/A ft<sup>2</sup>  
 Overflow Gate Open Area w/ Debris =  N/A ft<sup>2</sup>

**User Input:** Outlet Pipe w/ Flow Restriction Plate (Circular Orifice, Restrictor Plate, or Rectangular Orifice)

Depth to Invert of Outlet Pipe =  Not Selected  Not Selected ft (distance below basin bottom at Stage = 0 ft)  
 Circular Orifice Diameter =  N/A  N/A inches

**Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate**  
 Outlet Orifice Area =  Not Selected  Not Selected ft<sup>2</sup>  
 Outlet Orifice Centroid =  N/A  N/A feet  
 Half-Central Angle of Restrictor Plate on Pipe =  N/A  N/A radians

**User Input:** Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage =  2.50 ft (relative to basin bottom at Stage = 0 ft)  
 Spillway Crest Length =  5.00 feet  
 Spillway End Slopes =  4.00 H:V  
 Freeboard above Max Water Surface =  0.50 feet  
 Spillway position relative to Overflow Weir =  Overlapping

**Calculated Parameters for Spillway**  
 Spillway Design Flow Depth =  1.16 feet  
 Stage at Top of Freeboard =  4.16 feet  
 Basin Area at Top of Freeboard =  0.50 acres  
 Basin Volume at Top of Freeboard =  0.78 acre-ft

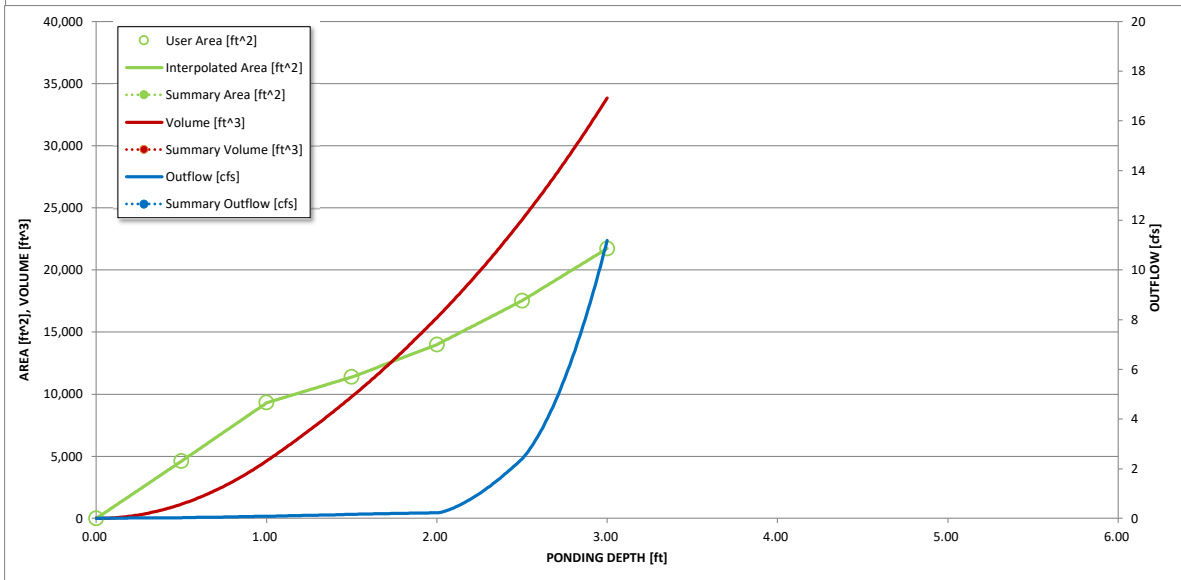
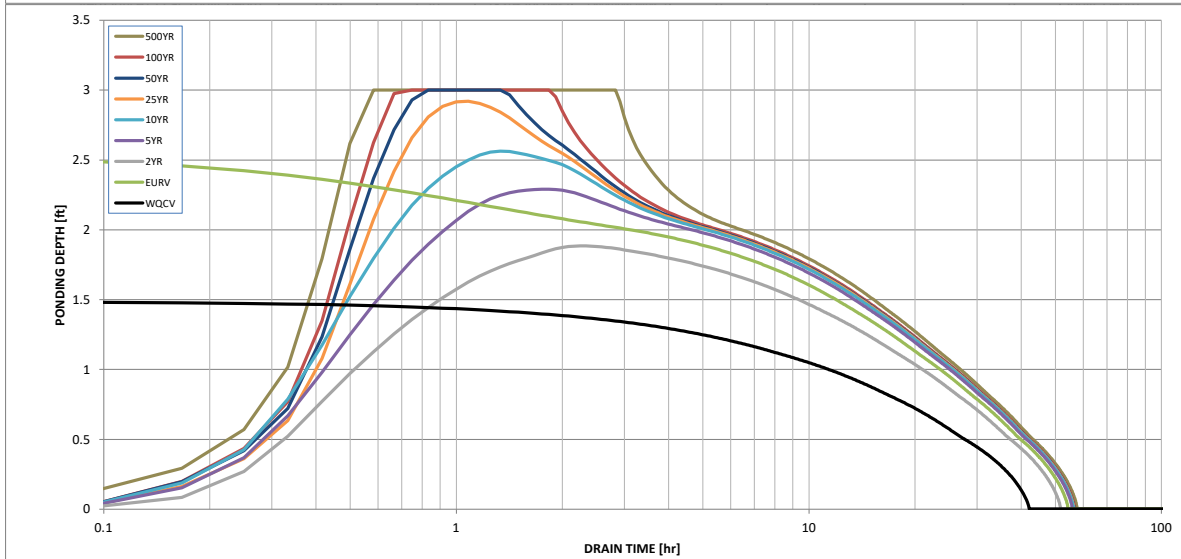
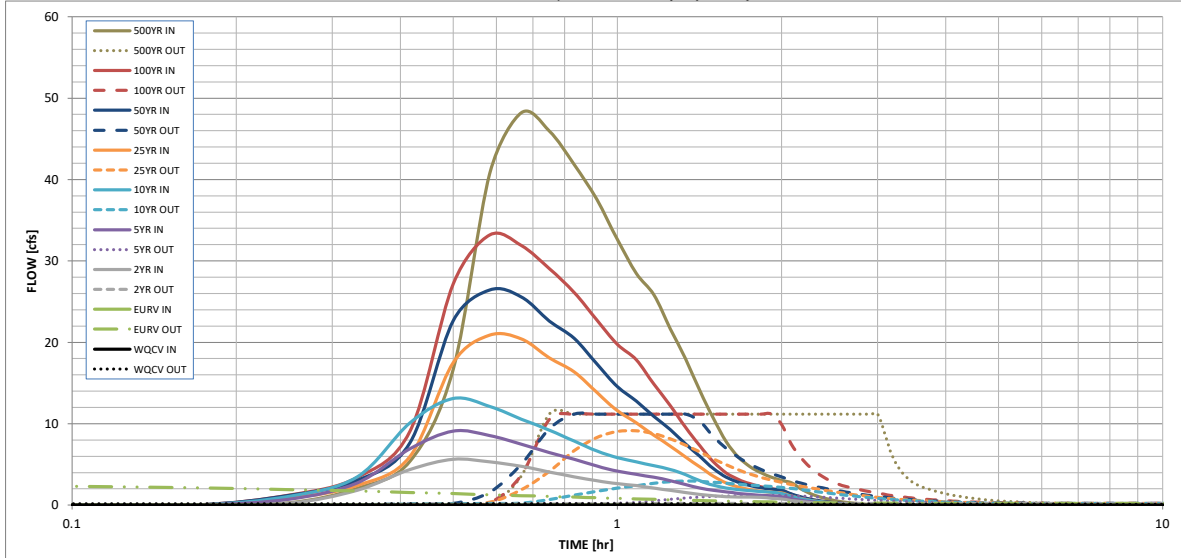
**Routed Hydrograph Results**

*The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).*

	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
Design Storm Return Period =	N/A	N/A	0.82	1.10	1.34	1.69	1.98	2.29	3.08
One-Hour Rainfall Depth (in) =	0.222	0.577	0.367	0.577	0.813	1.265	1.598	2.006	2.953
CUHP Runoff Volume (acre-ft) =	N/A	N/A	0.367	0.577	0.813	1.265	1.598	2.006	2.953
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.2	1.5	4.0	10.0	13.7	18.1	28.3
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.01	0.11	0.29	0.71	0.98	1.30	2.03
Peak Inflow Q (cfs) =	N/A	N/A	5.6	9.1	13.1	20.9	26.4	33.2	48.2
Peak Outflow Q (cfs) =	0.2	2.7	0.2	1.2	3.0	9.1	11.2	11.2	11.2
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.8	0.7	0.9	0.8	0.6	0.4
Structure Controlling Flow =	Plate	Spillway	Plate	Overflow Weir 1	Spillway	Spillway	N/A	N/A	N/A
Max Velocity through Gate 1 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Max Velocity through Gate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	37	44	44	45	43	39	36	34	30
Time to Drain 99% of Inflow Volume (hours) =	40	50	49	51	50	48	47	45	42
Maximum Ponding Depth (ft) =	1.49	2.57	1.88	2.29	2.56	2.92	3.00	3.00	3.00
Area at Maximum Ponding Depth (acres) =	0.26	0.42	0.31	0.37	0.41	0.48	0.50	0.50	0.50
Maximum Volume Stored (acre-ft) =	0.223	0.580	0.333	0.467	0.576	0.733	0.777	0.777	0.777
WSE =	5839.59	5840.67	5839.98	5840.39	5840.66	5841.02	5841.10	5841.10	5841.10

# DETENTION BASIN OUTLET STRUCTURE DESIGN

*MHFD-Detention, Version 4.06 (July 2022)*



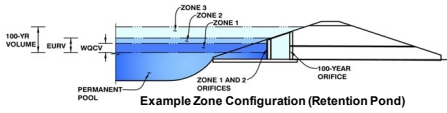
S-A-V-D Chart Axis Override	X-axis	Left Y-Axis	Right Y-Axis
minimum bound			
maximum bound			

# DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)

Project: **Salisbury Park North**

Basin ID: **Pond C - Phase 1**



### Watershed Information

Selected BMP Type =	<b>EDB</b>
Watershed Area =	11.40 acres
Watershed Length =	1,000 ft
Watershed Length to Centroid =	500 ft
Watershed Slope =	0.020 ft/ft
Watershed Imperviousness =	39.10% percent
Percentage Hydrologic Soil Group A =	0.0% percent
Percentage Hydrologic Soil Group B =	0.0% percent
Percentage Hydrologic Soil Groups C/D =	100.0% percent
Target WQC Drain Time =	40.0 hours
Location for 1-hr Rainfall Depths =	Parker - Town Hall

After providing required inputs above including 1-hour rainfall depths, click "Run CUHP" to generate runoff hydrographs using the embedded Colorado Urban Hydrograph Procedure.

Water Quality Capture Volume (WQCV) =	0.169	acre-feet
Excess Urban Runoff Volume (EURV) =	0.413	acre-feet
2-yr Runoff Volume (P1 = 0.82 in.) =	0.262	acre-feet
5-yr Runoff Volume (P1 = 1.1 in.) =	0.424	acre-feet
10-yr Runoff Volume (P1 = 1.34 in.) =	0.613	acre-feet
25-yr Runoff Volume (P1 = 1.69 in.) =	0.985	acre-feet
50-yr Runoff Volume (P1 = 1.98 in.) =	1.257	acre-feet
100-yr Runoff Volume (P1 = 2.29 in.) =	1.594	acre-feet
500-yr Runoff Volume (P1 = 3.08 in.) =	2.369	acre-feet
Approximate 2-yr Detention Volume =	0.249	acre-feet
Approximate 5-yr Detention Volume =	0.415	acre-feet
Approximate 10-yr Detention Volume =	0.496	acre-feet
Approximate 25-yr Detention Volume =	0.603	acre-feet
Approximate 50-yr Detention Volume =	0.653	acre-feet
Approximate 100-yr Detention Volume =	0.796	acre-feet

### Optional User Overrides

	acre-feet
	acre-feet
	inches
	inches
	inches
	inches
	inches
	inches
	inches
	inches

### Define Zones and Basin Geometry

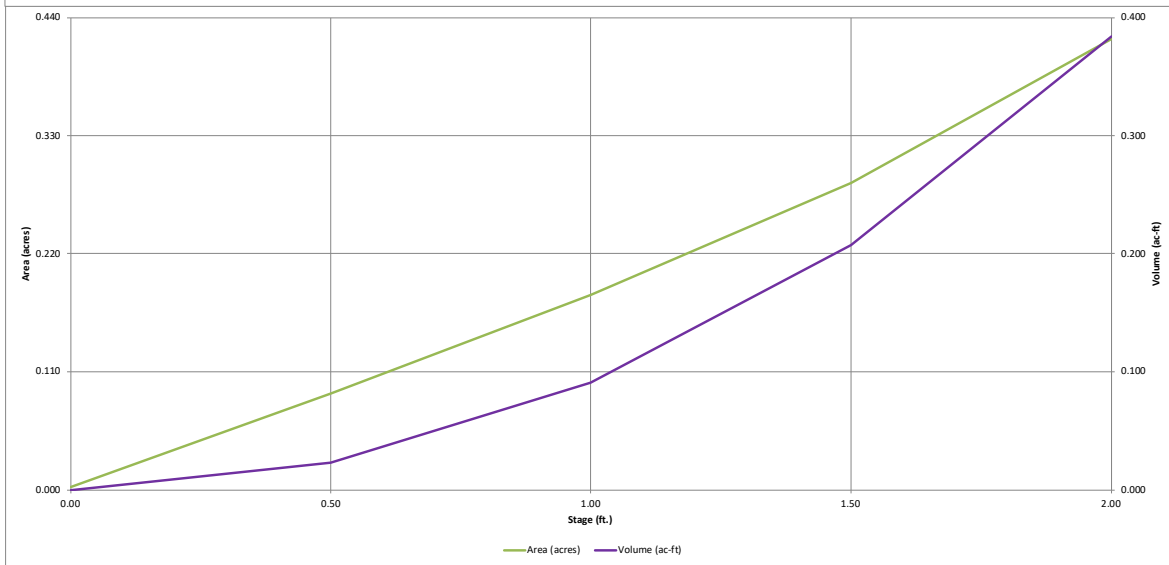
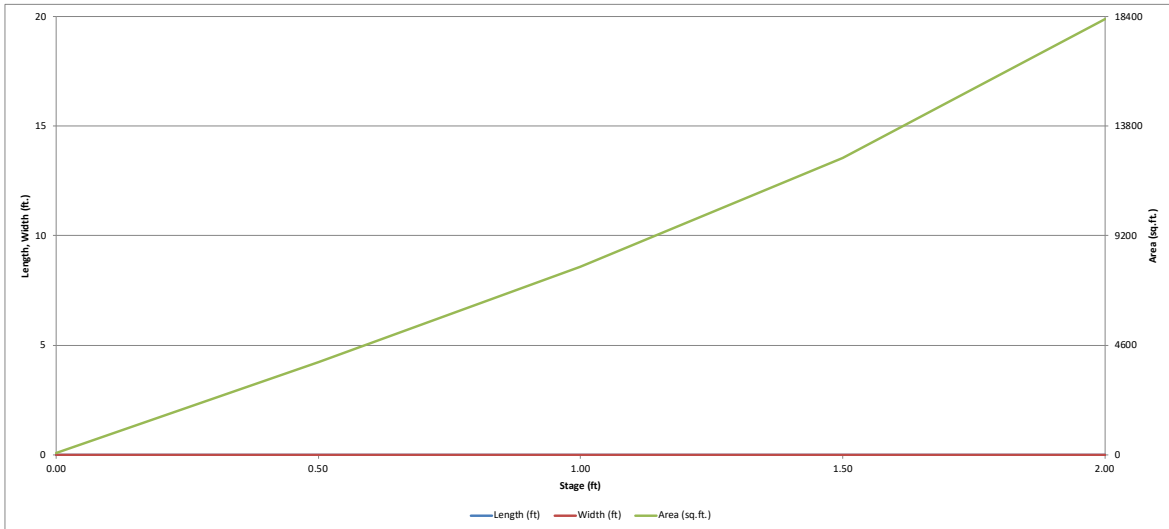
Zone 1 Volume (WQCV) =	0.169	acre-feet
Zone 2 Volume (2-year - Zone 1) =	0.080	acre-feet
Select Zone 3 Storage Volume (Optional) =	0.249	acre-feet
Total Detention Basin Volume =	0.249	acre-feet
Initial Surcharge Volume (ISV) =	user	ft <sup>3</sup>
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention Depth (H <sub>total</sub> ) =	user	ft
Depth of Trickle Channel (H <sub>TC</sub> ) =	user	ft
Slope of Trickle Channel (S <sub>TC</sub> ) =	user	ft/ft
Slopes of Main Basin Sides (S <sub>main</sub> ) =	user	H:V
Basin Length-to-Width Ratio (R <sub>LW</sub> ) =	user	
Initial Surcharge Area (A <sub>ISV</sub> ) =	user	ft <sup>2</sup>
Surcharge Volume Length (L <sub>ISV</sub> ) =	user	ft
Surcharge Volume Width (W <sub>ISV</sub> ) =	user	ft
Depth of Basin Floor (H <sub>FLOOR</sub> ) =	user	ft
Length of Basin Floor (L <sub>FLOOR</sub> ) =	user	ft
Width of Basin Floor (W <sub>FLOOR</sub> ) =	user	ft
Area of Basin Floor (A <sub>FLOOR</sub> ) =	user	ft <sup>2</sup>
Volume of Basin Floor (V <sub>FLOOR</sub> ) =	user	ft <sup>3</sup>
Depth of Main Basin (H <sub>MAIN</sub> ) =	user	ft
Length of Main Basin (L <sub>MAIN</sub> ) =	user	ft
Width of Main Basin (W <sub>MAIN</sub> ) =	user	ft
Area of Main Basin (A <sub>MAIN</sub> ) =	user	ft <sup>2</sup>
Volume of Main Basin (V <sub>MAIN</sub> ) =	user	ft <sup>3</sup>
Calculated Total Basin Volume (V <sub>total</sub> ) =	user	acre-feet

**Total detention volume is less than 100-year volume.**

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft <sup>2</sup> )	Optional Override Area (ft <sup>2</sup> )	Area (acre)	Volume (ft <sup>3</sup> )	Volume (ac-ft)
5844 Top of Micropool	--	0.00	--	--	--	107	0.002		
5844.5	--	0.50	--	--	--	3,894	0.089	1,000	0.023
5845	--	1.00	--	--	--	7,897	0.181	3,948	0.091
5845.5	--	1.50	--	--	--	12,464	0.286	9,038	0.207
5846	--	2.00	--	--	--	18,311	0.420	16,732	0.384

# DETENTION BASIN STAGE-STORAGE TABLE BUILDER

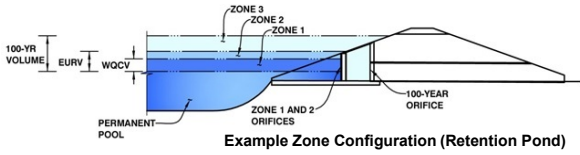
*MHFD-Detention, Version 4.06 (July 2022)*



# DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD- Detention, Version 4.06 (July 2022)

**Project:** Salisbury Park North  
**Basin ID:** Pond C - Phase 1



**Example Zone Configuration (Retention Pond)**

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	1.36	0.169	Orifice Plate
Zone 2 (2-year)	1.64	0.080	Weir&Pipe (Restrict)
Zone 3			
<b>Total (all zones)</b>		<b>0.249</b>	

**User Input:** Orifice at Underdrain Outlet (typically used to drain WOCV in a Filtration BMP)

Underdrain Orifice Invert Depth =  ft (distance below the filtration media surface)  
 Underdrain Orifice Diameter =  inches

**Calculated Parameters for Underdrain**  
 Underdrain Orifice Area =  ft<sup>2</sup>  
 Underdrain Orifice Centroid =  feet

**User Input:** Orifice Plate with one or more orifices or Elliptical Slot Weir (typically used to drain WOCV and/or EURV in a sedimentation BMP)

Centroid of Lowest Orifice =  ft (relative to basin bottom at Stage = 0 ft)  
 Depth at top of Zone using Orifice Plate =  ft (relative to basin bottom at Stage = 0 ft)  
 Orifice Plate: Orifice Vertical Spacing =  inches  
 Orifice Plate: Orifice Area per Row =  sq. inches (diameter = 1-1/8 inches)

**Calculated Parameters for Plate**  
 WQ Orifice Area per Row =  ft<sup>2</sup>  
 Elliptical Half-Width =  feet  
 Elliptical Slot Centroid =  feet  
 Elliptical Slot Area =  ft<sup>2</sup>

**User Input:** Stage and Total Area of Each Orifice Row (numbered from lowest to highest)

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	0.50	0.80	1.10				
Orifice Area (sq. inches)	1.02	1.02	1.02	1.02				

	Row 9 (optional)	Row 10 (optional)	Row 11 (optional)	Row 12 (optional)	Row 13 (optional)	Row 14 (optional)	Row 15 (optional)	Row 16 (optional)
Stage of Orifice Centroid (ft)								
Orifice Area (sq. inches)								

**User Input:** Vertical Orifice (Circular or Rectangular)

Invert of Vertical Orifice =   ft (relative to basin bottom at Stage = 0 ft)  
 Depth at top of Zone using Vertical Orifice =  ft (relative to basin bottom at Stage = 0 ft)  
 Vertical Orifice Diameter =  inches

**Calculated Parameters for Vertical Orifice**  
 Vertical Orifice Area =  ft<sup>2</sup>  
 Vertical Orifice Centroid =  feet

**User Input:** Overflow Weir (Dropbox with Flat or Sloped Gate and Outlet Pipe OR Rectangular/Trapezoidal Weir and No Outlet Pipe)

Overflow Weir Front Edge Height, Ho =  ft (relative to basin bottom at Stage = 0 ft)  
 Overflow Weir Front Edge Length =  feet  
 Overflow Weir Gate Slope =  H:V  
 Horiz. Length of Weir Sides =  feet  
 Overflow Gate Type =   
 Debris Clogging % =  %

**Calculated Parameters for Overflow Weir**  
 Height of Gate Upper Edge, H<sub>1</sub> =  feet  
 Overflow Weir Slope Length =  feet  
 Gate Open Area / 100-yr Orifice Area =   
 Overflow Gate Open Area w/o Debris =  ft<sup>2</sup>  
 Overflow Gate Open Area w/ Debris =  ft<sup>2</sup>

**User Input:** Outlet Pipe w/ Flow Restriction Plate (Circular Orifice, Restrictor Plate, or Rectangular Orifice)

Depth to Invert of Outlet Pipe =  ft (distance below basin bottom at Stage = 0 ft)  
 Outlet Pipe Diameter =  inches  
 Restrictor Plate Height Above Pipe Invert =  inches

**Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate**  
 Outlet Orifice Area =  ft<sup>2</sup>  
 Outlet Orifice Centroid =  feet  
 Half-Central Angle of Restrictor Plate on Pipe =  radians

**User Input:** Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage =  ft (relative to basin bottom at Stage = 0 ft)  
 Spillway Crest Length =  feet  
 Spillway End Slopes =  H:V  
 Freeboard above Max Water Surface =  feet

**Calculated Parameters for Spillway**  
 Spillway Design Flow Depth =  feet  
 Stage at Top of Freeboard =  feet  
 Basin Area at Top of Freeboard =  acres  
 Basin Volume at Top of Freeboard =  acre-ft

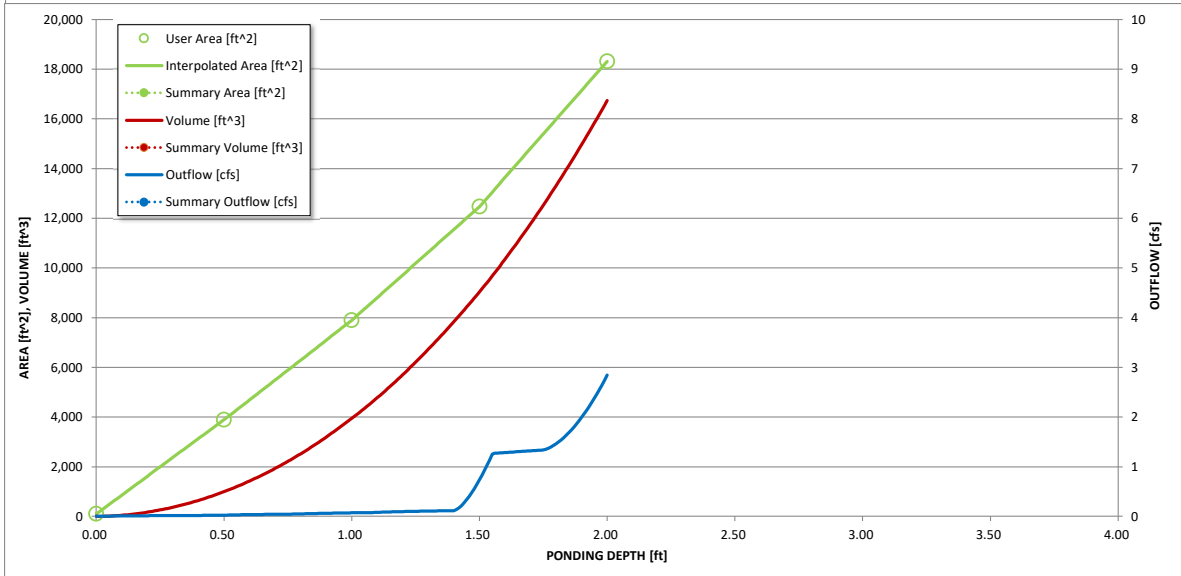
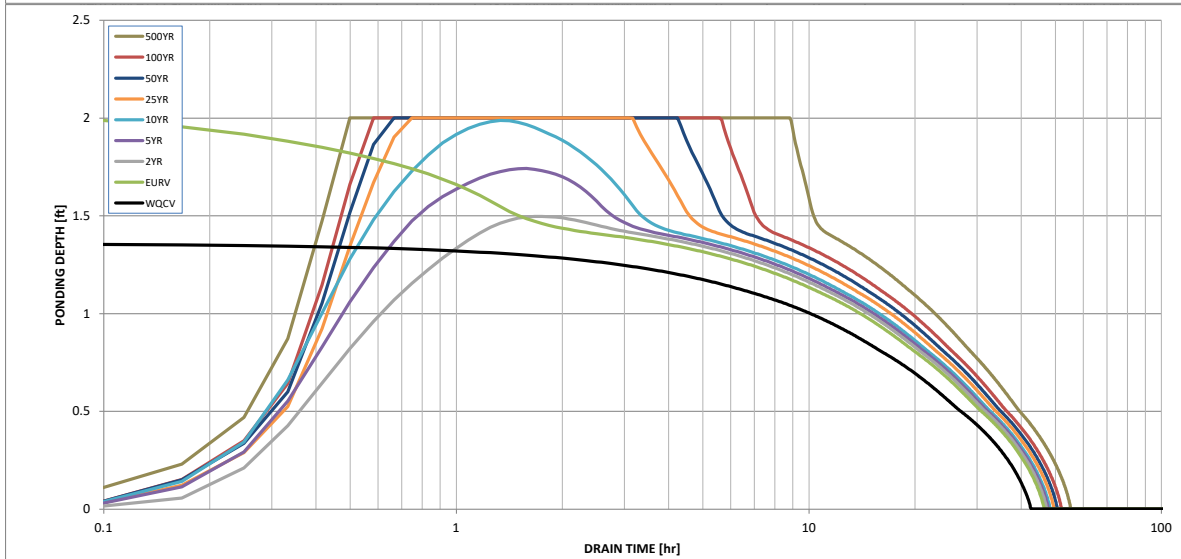
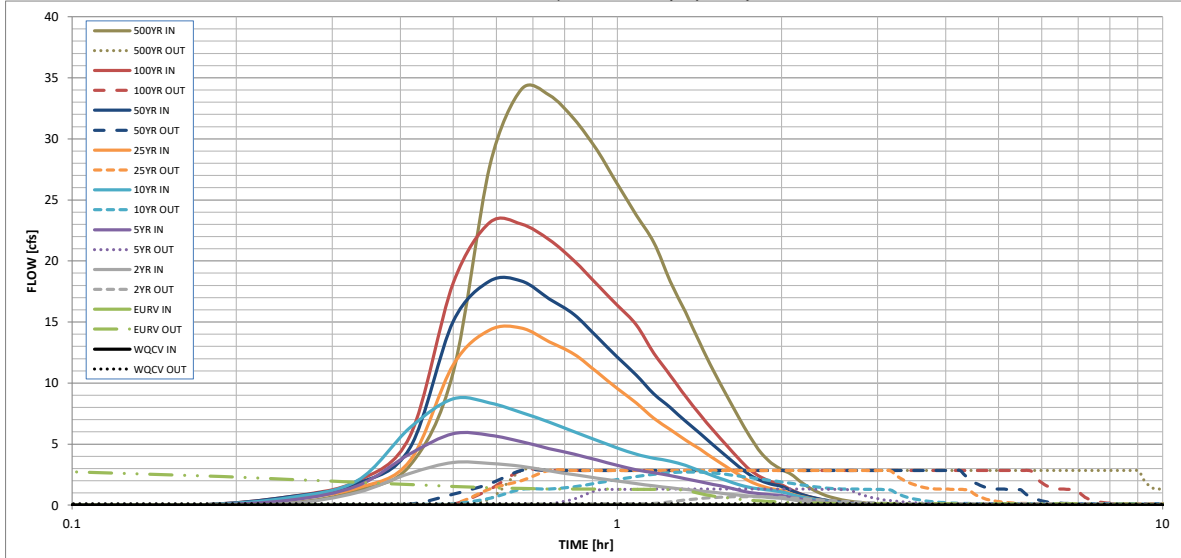
**Routed Hydrograph Results**

The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).

	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
Design Storm Return Period =	N/A	N/A	0.82	1.10	1.34	1.69	1.98	2.29	3.08
One-Hour Rainfall Depth (in) =	N/A	N/A	0.262	0.424	0.613	0.985	1.257	1.594	2.369
CUHP Runoff Volume (acre-ft) =	N/A	N/A	0.262	0.424	0.613	0.985	1.257	1.594	2.369
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.1	1.1	3.0	7.5	10.3	13.9	21.7
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A							
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.01	0.10	0.27	0.66	0.90	1.22	1.90
Peak Inflow Q (cfs) =	N/A	N/A	3.5	5.8	8.7	14.5	18.4	23.1	34.1
Peak Outflow Q (cfs) =	0.1	2.8	0.7	1.3	2.7	2.8	2.8	2.8	2.8
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	1.2	0.9	0.4	0.3	0.2	0.1
Structure Controlling Flow =	Plate	N/A	Overflow Weir 1	Outlet Plate 1	Spillway	N/A	N/A	N/A	N/A
Max Velocity through Gate 1 (fps) =	N/A	0.20	0.10	0.2	0.2	0.2	0.2	0.2	0.2
Max Velocity through Gate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	38	37	40	38	35	31	30	28	26
Time to Drain 99% of Inflow Volume (hours) =	40	42	44	43	42	41	41	40	39
Maximum Ponding Depth (ft) =	1.36	2.00	1.50	1.74	1.99	2.00	2.00	2.00	2.00
Area at Maximum Ponding Depth (acres) =	0.26	0.42	0.28	0.35	0.41	0.42	0.42	0.42	0.42
Maximum Volume Stored (acre-ft) =	0.169	0.380	0.205	0.284	0.376	0.384	0.384	0.384	0.384

# DETENTION BASIN OUTLET STRUCTURE DESIGN

*MHFD-Detention, Version 4.06 (July 2022)*



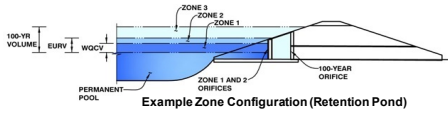
S-A-V-D Chart Axis Override	X-axis	Left Y-Axis	Right Y-Axis
minimum bound			
maximum bound			

# DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)

Project: **Salisbury Park North**

Basin ID: **Pond D - Phase 1**



**Watershed Information**

Selected BMP Type =	<b>EDB</b>
Watershed Area =	7.70 acres
Watershed Length =	1,000 ft
Watershed Length to Centroid =	500 ft
Watershed Slope =	0.015 ft/ft
Watershed Imperviousness =	51.10% percent
Percentage Hydrologic Soil Group A =	0.0% percent
Percentage Hydrologic Soil Group B =	0.0% percent
Percentage Hydrologic Soil Groups C/D =	100.0% percent
Target WQC Drain Time =	40.0 hours
Location for 1-hr Rainfall Depths =	Parker - Town Hall

After providing required inputs above including 1-hour rainfall depths, click "Run CUHP" to generate runoff hydrographs using the embedded Colorado Urban Hydrograph Procedure.

Water Quality Capture Volume (WQCV) =	0.134 acre-feet
Excess Urban Runoff Volume (EURV) =	0.373 acre-feet
2-yr Runoff Volume (P1 = 0.82 in.) =	0.240 acre-feet
5-yr Runoff Volume (P1 = 1.1 in.) =	0.366 acre-feet
10-yr Runoff Volume (P1 = 1.34 in.) =	0.502 acre-feet
25-yr Runoff Volume (P1 = 1.69 in.) =	0.751 acre-feet
50-yr Runoff Volume (P1 = 1.98 in.) =	0.938 acre-feet
100-yr Runoff Volume (P1 = 2.29 in.) =	1.163 acre-feet
500-yr Runoff Volume (P1 = 3.08 in.) =	1.692 acre-feet
Approximate 2-yr Detention Volume =	0.228 acre-feet
Approximate 5-yr Detention Volume =	0.358 acre-feet
Approximate 10-yr Detention Volume =	0.427 acre-feet
Approximate 25-yr Detention Volume =	0.509 acre-feet
Approximate 50-yr Detention Volume =	0.549 acre-feet
Approximate 100-yr Detention Volume =	0.642 acre-feet

**Optional User Overrides**

acre-feet	acre-feet
acre-feet	acre-feet
inches	inches
inches	inches
inches	inches
inches	inches
inches	inches
inches	inches
inches	inches
inches	inches

**Define Zones and Basin Geometry**

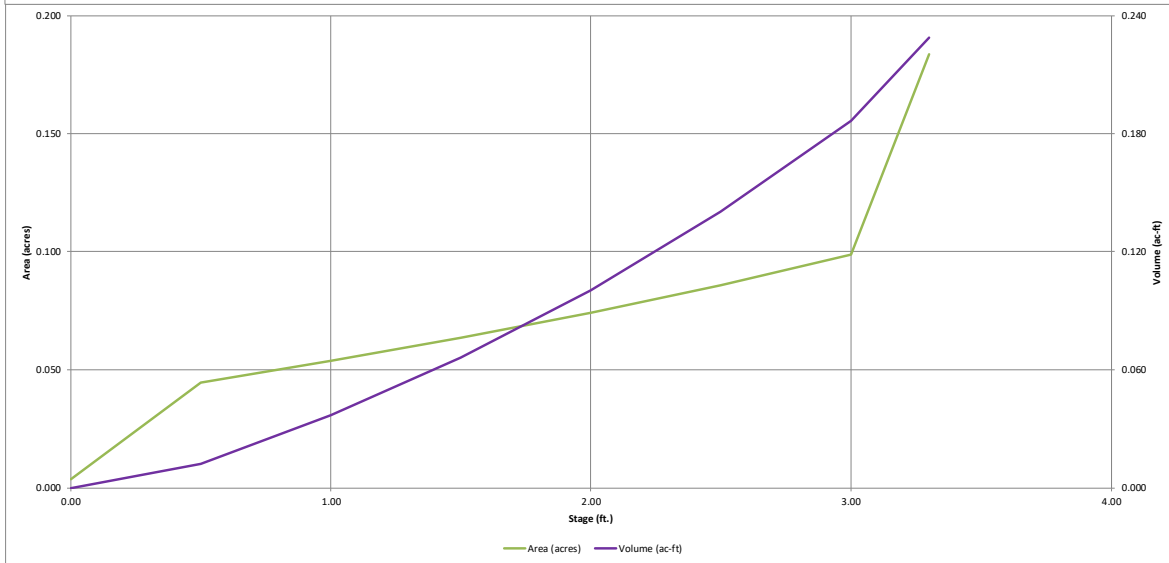
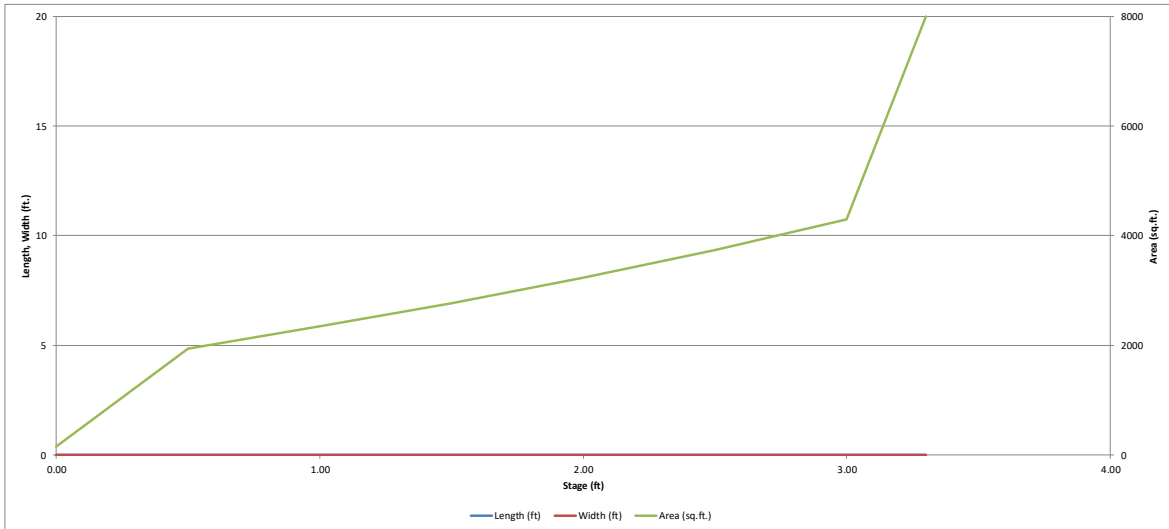
Zone 1 Volume (WQCV) =	0.134 acre-feet
Zone 2 Volume (2-year - Zone 1) =	0.093 acre-feet
Select Zone 3 Storage Volume (Optional) =	acre-feet
Total Detention Basin Volume =	0.228 acre-feet
Initial Surcharge Volume (ISV) =	user ft <sup>3</sup>
Initial Surcharge Depth (ISD) =	user ft
Total Available Detention Depth (H <sub>total</sub> ) =	user ft
Depth of Trickle Channel (H <sub>TC</sub> ) =	user ft
Slope of Trickle Channel (S <sub>TC</sub> ) =	user ft/ft
Slopes of Main Basin Sides (S <sub>main</sub> ) =	user H:V
Basin Length-to-Width Ratio (R <sub>L/W</sub> ) =	user
Initial Surcharge Area (A <sub>ISV</sub> ) =	user ft <sup>2</sup>
Surcharge Volume Length (L <sub>ISV</sub> ) =	user ft
Surcharge Volume Width (W <sub>ISV</sub> ) =	user ft
Depth of Basin Floor (H <sub>FLOOR</sub> ) =	user ft
Length of Basin Floor (L <sub>FLOOR</sub> ) =	user ft
Width of Basin Floor (W <sub>FLOOR</sub> ) =	user ft
Area of Basin Floor (A <sub>FLOOR</sub> ) =	user ft <sup>2</sup>
Volume of Basin Floor (V <sub>FLOOR</sub> ) =	user ft <sup>3</sup>
Depth of Main Basin (H <sub>MAN</sub> ) =	user ft
Length of Main Basin (L <sub>MAN</sub> ) =	user ft
Width of Main Basin (W <sub>MAN</sub> ) =	user ft
Area of Main Basin (A <sub>MAN</sub> ) =	user ft <sup>2</sup>
Volume of Main Basin (V <sub>MAN</sub> ) =	user ft <sup>3</sup>
Calculated Total Basin Volume (V <sub>total</sub> ) =	user acre-feet

**Total detention volume is less than 100-year volume.**

Depth Increment =	0.50	ft									
Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft <sup>2</sup> )	Optional Override Area (ft <sup>2</sup> )	Area (acre)	Volume (ft <sup>3</sup> )	Volume (ac-ft)		
5845.3 Top of Micropool	--	0.00	--	--	--	155	0.004				
5845.8	--	0.50	--	--	--	1,944	0.045	525	0.012		
5846.3	--	1.00	--	--	--	2,345	0.054	1,597	0.037		
5846.8	--	1.50	--	--	--	2,767	0.064	2,875	0.066		
5847.3	--	2.00	--	--	--	3,230	0.074	4,374	0.100		
5847.8	--	2.50	--	--	--	3,738	0.086	6,116	0.140		
5848.3	--	3.00	--	--	--	4,297	0.099	8,125	0.187		
5848.6	--	3.30	--	--	--	8,000	0.184	9,969	0.229		

# DETENTION BASIN STAGE-STORAGE TABLE BUILDER

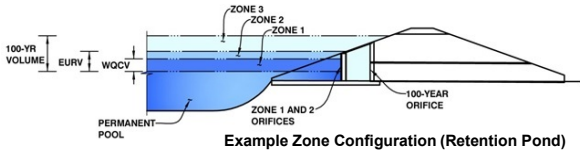
*MHFD-Detention, Version 4.06 (July 2022)*



# DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

**Project:** Salisbury Park North  
**Basin ID:** Pond D - Phase 1



	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	2.43	0.134	Orifice Plate
Zone 2 (2-year)	3.30	0.093	Weir (No Pipe)
Zone 3			
<b>Total (all zones)</b>		<b>0.228</b>	

**Example Zone Configuration (Retention Pond)**

**User Input: Orifice at Underdrain Outlet (typically used to drain WQCV in a Filtration BMP)**

Underdrain Orifice Invert Depth =  ft (distance below the filtration media surface)  
 Underdrain Orifice Diameter =  inches

**Calculated Parameters for Underdrain**  
 Underdrain Orifice Area =  ft<sup>2</sup>  
 Underdrain Orifice Centroid =  feet

**User Input: Orifice Plate with one or more orifices or Elliptical Slot Weir (typically used to drain WQCV and/or EURV in a sedimentation BMP)**

Centroid of Lowest Orifice =  ft (relative to basin bottom at Stage = 0 ft)  
 Depth at top of Zone using Orifice Plate =  ft (relative to basin bottom at Stage = 0 ft)  
 Orifice Plate: Orifice Vertical Spacing =  inches  
 Orifice Plate: Orifice Area per Row =  sq. inches (diameter = 1 inch)

**Calculated Parameters for Plate**  
 WQ Orifice Area per Row =  ft<sup>2</sup>  
 Elliptical Half-Width =  feet  
 Elliptical Slot Centroid =  feet  
 Elliptical Slot Area =  ft<sup>2</sup>

**User Input: Stage and Total Area of Each Orifice Row (numbered from lowest to highest)**

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	1.00	2.00					
Orifice Area (sq. inches)	0.85	0.85	0.85					

	Row 9 (optional)	Row 10 (optional)	Row 11 (optional)	Row 12 (optional)	Row 13 (optional)	Row 14 (optional)	Row 15 (optional)	Row 16 (optional)
Stage of Orifice Centroid (ft)								
Orifice Area (sq. inches)								

**User Input: Vertical Orifice (Circular or Rectangular)**

Invert of Vertical Orifice =   ft (relative to basin bottom at Stage = 0 ft)  
 Depth at top of Zone using Vertical Orifice =  ft (relative to basin bottom at Stage = 0 ft)  
 Vertical Orifice Diameter =  inches

**Calculated Parameters for Vertical Orifice**  
 Vertical Orifice Area =  ft<sup>2</sup>  
 Vertical Orifice Centroid =  feet

**User Input: Overflow Weir (Dropbox with Flat or Sloped Gate and Outlet Pipe OR Rectangular/Trapezoidal Weir and No Outlet Pipe)**

Overflow Weir Front Edge Height, Ho =  ft (relative to basin bottom at Stage = 0 ft)  
 Overflow Weir Bottom Length =  feet  
 Overflow Weir Side Slopes =  H:V  
 Horiz. Length of Weir Sides =  feet  
 Overflow Gate Type =   
 Debris Clogging % =  %

**Calculated Parameters for Overflow Weir**  
 Height of Gate Upper Edge, H<sub>g</sub> =  feet  
 Overflow Weir Slope Length =  feet  
 Gate Open Area / 100-yr Orifice Area =   
 Overflow Gate Open Area w/o Debris =  ft<sup>2</sup>  
 Overflow Gate Open Area w/ Debris =  ft<sup>2</sup>

**User Input: Outlet Pipe w/ Flow Restriction Plate (Circular Orifice, Restrictor Plate, or Rectangular Orifice)**

Depth to Invert of Outlet Pipe =  ft (distance below basin bottom at Stage = 0 ft)  
 Circular Orifice Diameter =  inches

**Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate**  
 Outlet Orifice Area =  ft<sup>2</sup>  
 Outlet Orifice Centroid =  feet  
 Half-Central Angle of Restrictor Plate on Pipe =  radians

**User Input: Emergency Spillway (Rectangular or Trapezoidal)**

Spillway Invert Stage =  ft (relative to basin bottom at Stage = 0 ft)  
 Spillway Crest Length =  feet  
 Spillway End Slopes =  H:V  
 Freeboard above Max Water Surface =  feet  
 Spillway position relative to Overflow Weir =

**Calculated Parameters for Spillway**  
 Spillway Design Flow Depth =  feet  
 Stage at Top of Freeboard =  feet  
 Basin Area at Top of Freeboard =  acres  
 Basin Volume at Top of Freeboard =  acre-ft

**Routed Hydrograph Results**

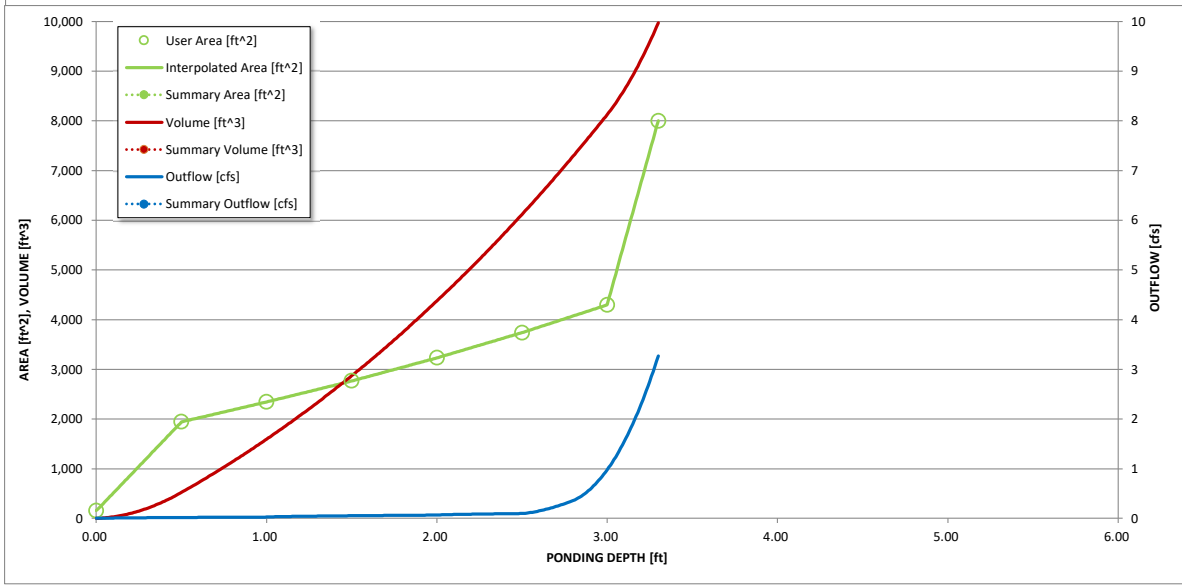
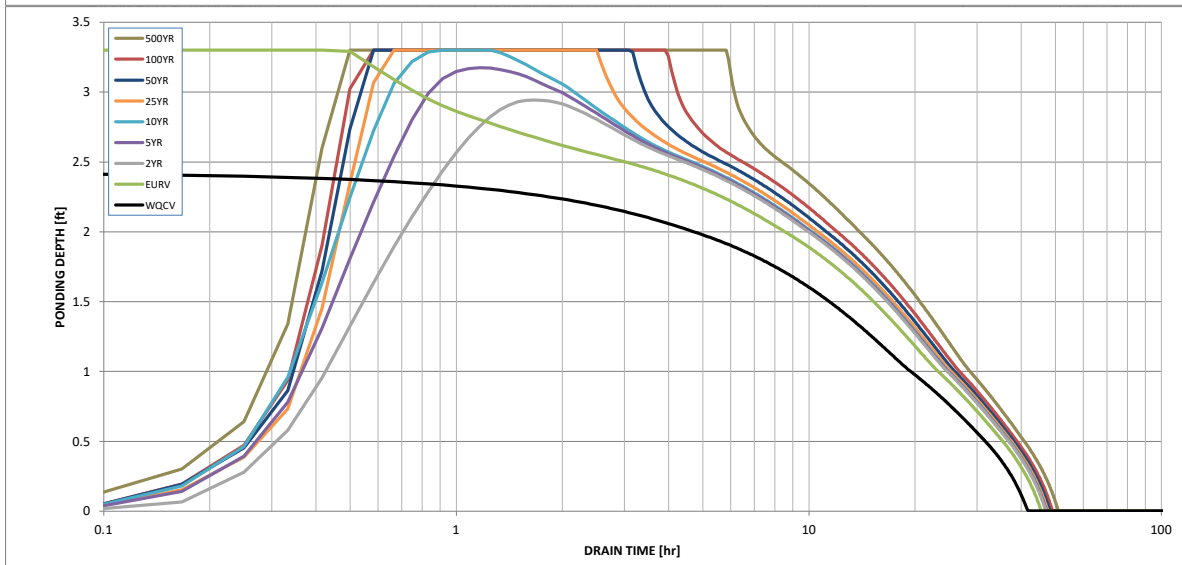
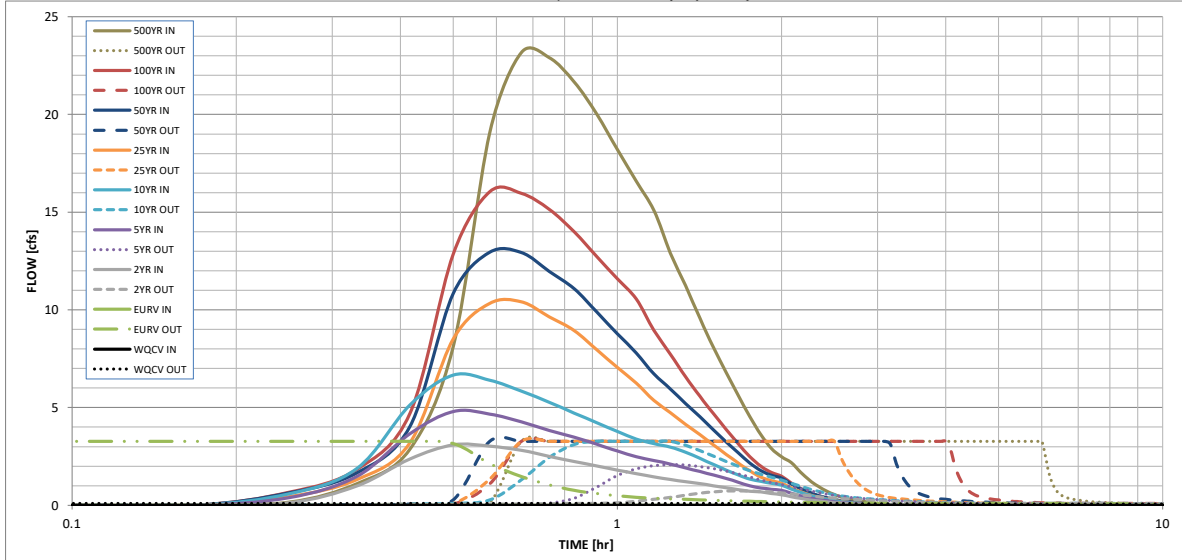
*The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).*

	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
Design Storm Return Period	N/A	N/A	0.82	1.10	1.34	1.69	1.98	2.29	3.08
One-Hour Rainfall Depth (in)	N/A	N/A	0.82	1.10	1.34	1.69	1.98	2.29	3.08
CUHP Runoff Volume (acre-ft)	0.134	0.373	0.240	0.366	0.502	0.751	0.938	1.163	1.692
Inflow Hydrograph Volume (acre-ft)	N/A	N/A	0.240	0.366	0.502	0.751	0.938	1.163	1.692
CUHP Predevelopment Peak Q (cfs)	N/A	N/A	0.1	0.6	1.7	4.2	5.8	7.8	12.3
OPTIONAL Override Predevelopment Peak Q (cfs)	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre)	N/A	N/A	0.01	0.08	0.22	0.55	0.75	1.02	1.59
Peak Inflow Q (cfs)	N/A	N/A	3.1	4.8	6.7	10.4	12.9	16.1	23.2
Peak Outflow Q (cfs)	0.1	3.3	0.7	2.1	3.3	3.3	3.3	3.3	3.3
Ratio Peak Outflow to Predevelopment Q	N/A	N/A	N/A	3.4	2.0	0.8	0.6	0.4	0.3
Structure Controlling Flow	Plate	N/A	Spillway	Spillway	N/A	N/A	N/A	N/A	N/A
Max Velocity through Gate 1 (fps)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Max Velocity through Gate 2 (fps)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours)	37	36	40	38	35	32	30	28	24
Time to Drain 99% of Inflow Volume (hours)	40	41	44	43	42	41	40	39	38
Maximum Ponding Depth (ft)	2.43	3.30	2.94	3.17	3.30	3.30	3.30	3.30	3.30
Area at Maximum Ponding Depth (acres)	0.08	0.18	0.10	0.15	0.18	0.18	0.18	0.18	0.18
Maximum Volume Stored (acre-ft)	0.134	0.229	0.181	0.207	0.229	0.229	0.229	0.229	0.229
WSE	5842.03	5842.90	5842.54	5842.77	5842.90	5842.90	5842.90	5842.90	5842.90

Please help staff understand why proposed calculations are one-lined/crossed out for Pond D Phase 1.

# DETENTION BASIN OUTLET STRUCTURE DESIGN

*MHFD-Detention, Version 4.06 (July 2022)*

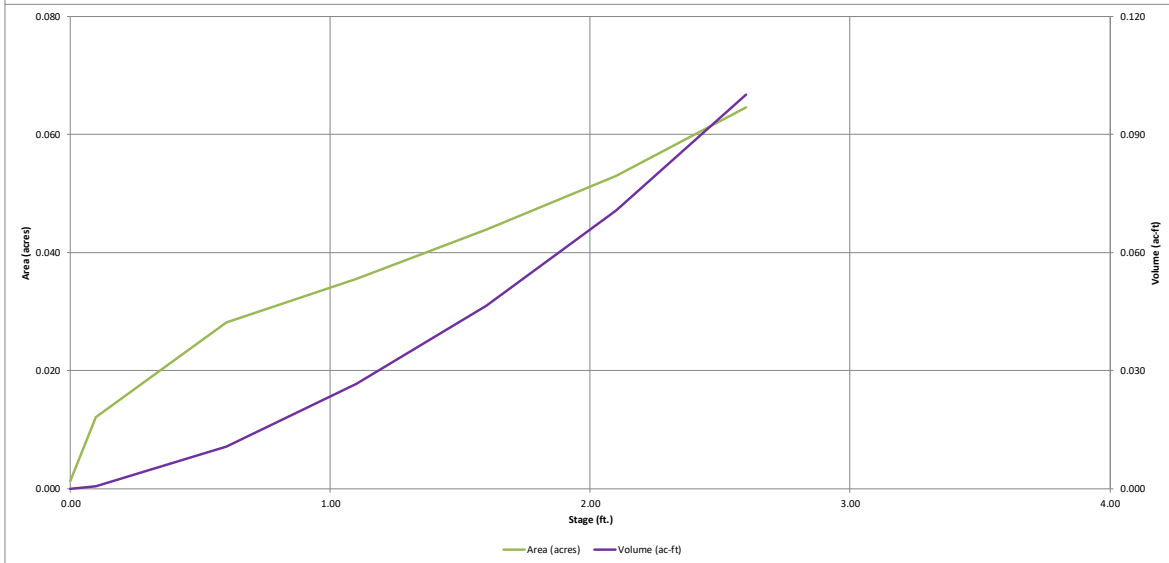
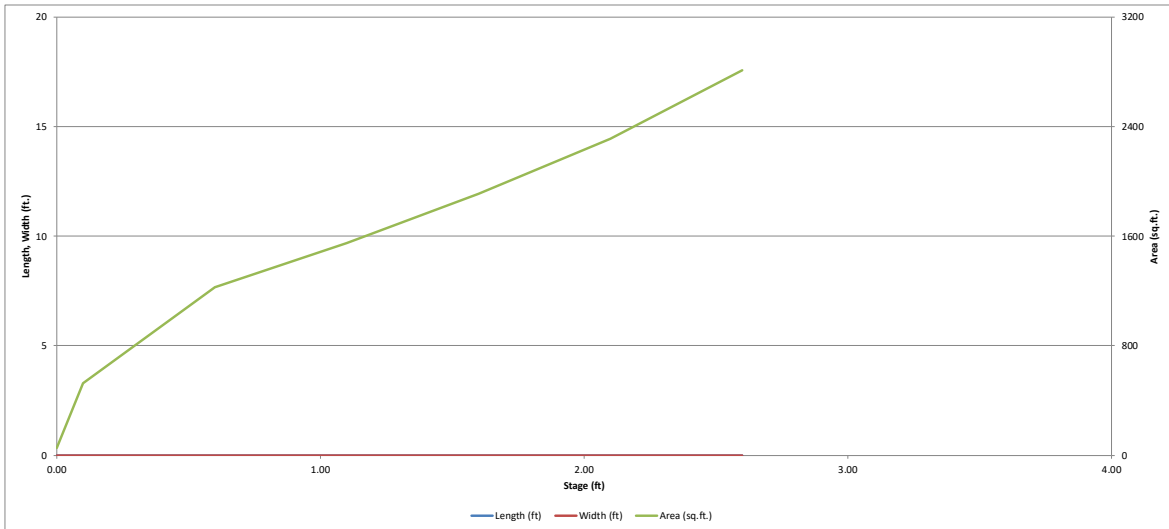


S-A-V-D Chart Axis Override	X-axis	Left Y-Axis	Right Y-Axis
minimum bound			
maximum bound			



# DETENTION BASIN STAGE-STORAGE TABLE BUILDER

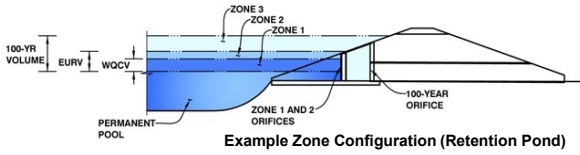
*MHFD-Detention, Version 4.06 (July 2022)*



# DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-*Detention*, Version 4.06 (July 2022)

**Project:** Salisbury Park North  
**Basin ID:** Pond E - Phase 1



	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	1.41	0.038	Orifice Plate
Zone 2 (2-year)	2.07	0.031	Weir (No Pipe)
Zone 3			
<b>Total (all zones)</b>		<b>0.069</b>	

**User Input:** Orifice at Underdrain Outlet (typically used to drain WQCV in a Filtration BMP)

Underdrain Orifice Invert Depth =  ft (distance below the filtration media surface)  
 Underdrain Orifice Diameter =  inches

**Calculated Parameters for Underdrain**  
 Underdrain Orifice Area =  ft<sup>2</sup>  
 Underdrain Orifice Centroid =  feet

**User Input:** Orifice Plate with one or more orifices or Elliptical Slot Weir (typically used to drain WQCV and/or EURV in a sedimentation BMP)

Centroid of Lowest Orifice =  ft (relative to basin bottom at Stage = 0 ft)  
 Depth at top of Zone using Orifice Plate =  ft (relative to basin bottom at Stage = 0 ft)  
 Orifice Plate: Orifice Vertical Spacing =  inches  
 Orifice Plate: Orifice Area per Row =  sq. inches (diameter = 5/8 inch)

**Calculated Parameters for Plate**  
 WQ Orifice Area per Row =  ft<sup>2</sup>  
 Elliptical Half-Width =  feet  
 Elliptical Slot Centroid =  feet  
 Elliptical Slot Area =  ft<sup>2</sup>

**User Input:** Stage and Total Area of Each Orifice Row (numbered from lowest to highest)

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	0.47	0.94					
Orifice Area (sq. inches)	0.29	0.29	0.29					

	Row 9 (optional)	Row 10 (optional)	Row 11 (optional)	Row 12 (optional)	Row 13 (optional)	Row 14 (optional)	Row 15 (optional)	Row 16 (optional)
Stage of Orifice Centroid (ft)								
Orifice Area (sq. inches)								

**User Input:** Vertical Orifice (Circular or Rectangular)

Invert of Vertical Orifice =   ft (relative to basin bottom at Stage = 0 ft)  
 Depth at top of Zone using Vertical Orifice =   ft (relative to basin bottom at Stage = 0 ft)  
 Vertical Orifice Diameter =   inches

**Calculated Parameters for Vertical Orifice**  
 Vertical Orifice Area =   ft<sup>2</sup>  
 Vertical Orifice Centroid =   feet

**User Input:** Overflow Weir (Dropbox with Flat or Sloped Gate and Outlet Pipe OR Rectangular/Trapezoidal Weir and No Outlet Pipe)

Overflow Weir Front Edge Height, Ho =  ft (relative to basin bottom at Stage = 0 ft)  
 Overflow Weir Bottom Length =  feet  
 Overflow Weir Side Slopes =  H:V  
 Horiz. Length of Weir Sides =  feet  
 Overflow Gate Type =   
 Debris Clogging % =  %

**Calculated Parameters for Overflow Weir**  
 Height of Gate Upper Edge, H<sub>g</sub> =  feet  
 Overflow Weir Slope Length =  feet  
 Gate Open Area / 100-yr Orifice Area =   
 Overflow Gate Open Area w/o Debris =  ft<sup>2</sup>  
 Overflow Gate Open Area w/ Debris =  ft<sup>2</sup>

**User Input:** Outlet Pipe w/ Flow Restriction Plate (Circular Orifice, Restrictor Plate, or Rectangular Orifice)

Depth to Invert of Outlet Pipe =   ft (distance below basin bottom at Stage = 0 ft)  
 Circular Orifice Diameter =   inches

**Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate**  
 Outlet Orifice Area =   ft<sup>2</sup>  
 Outlet Orifice Centroid =   feet  
 Half-Central Angle of Restrictor Plate on Pipe =   radians

**User Input:** Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage =  ft (relative to basin bottom at Stage = 0 ft)  
 Spillway Crest Length =  feet  
 Spillway End Slopes =  H:V  
 Freeboard above Max Water Surface =  feet  
 Spillway position relative to Overflow Weir =

**Calculated Parameters for Spillway**  
 Spillway Design Flow Depth =  feet  
 Stage at Top of Freeboard =  feet  
 Basin Area at Top of Freeboard =  acres  
 Basin Volume at Top of Freeboard =  acre-ft

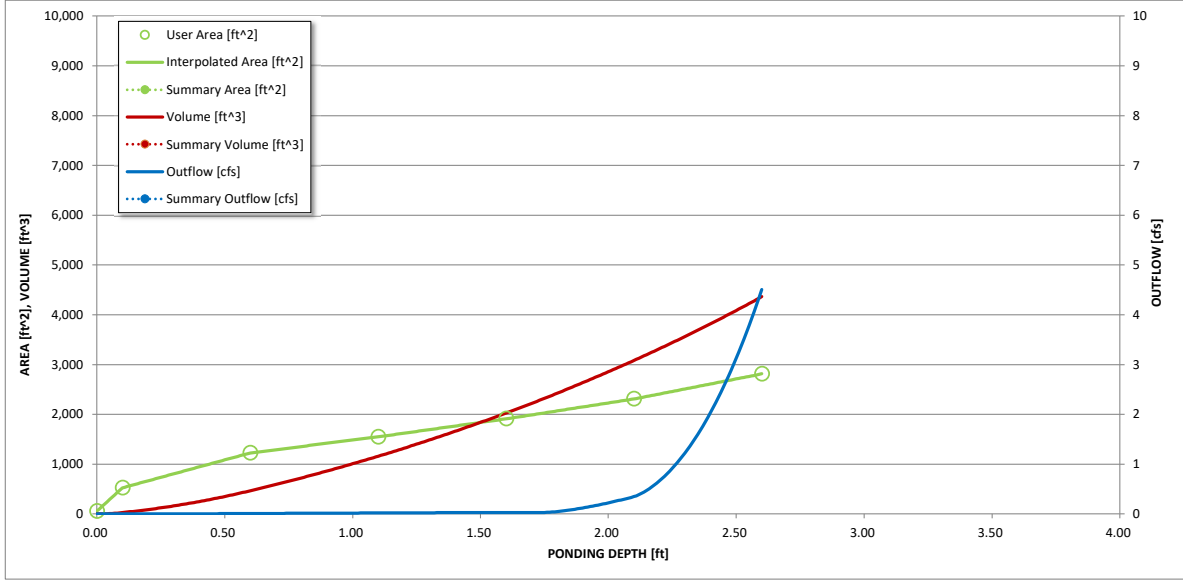
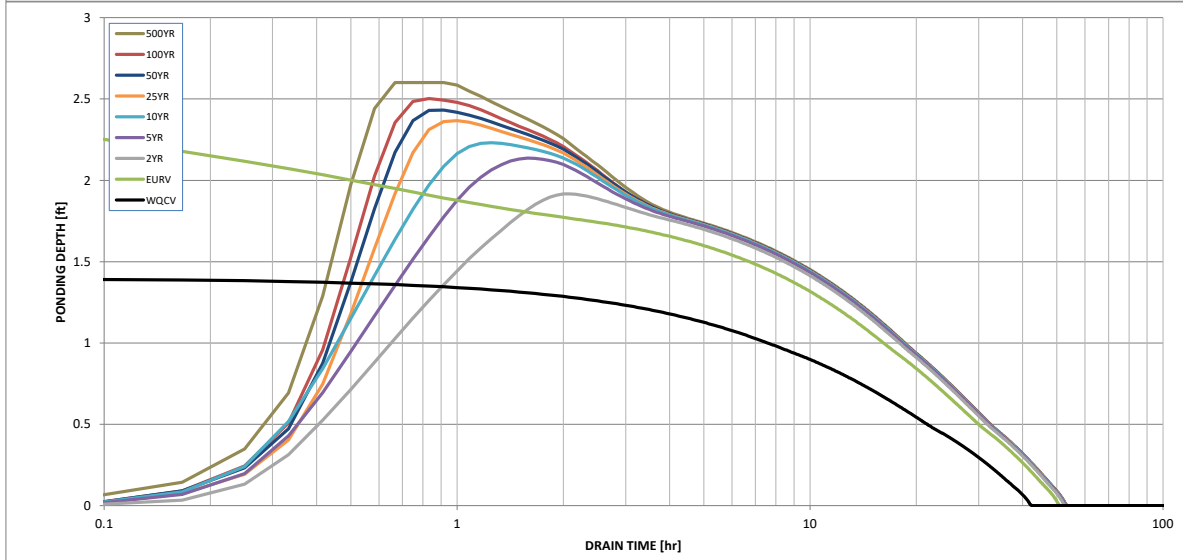
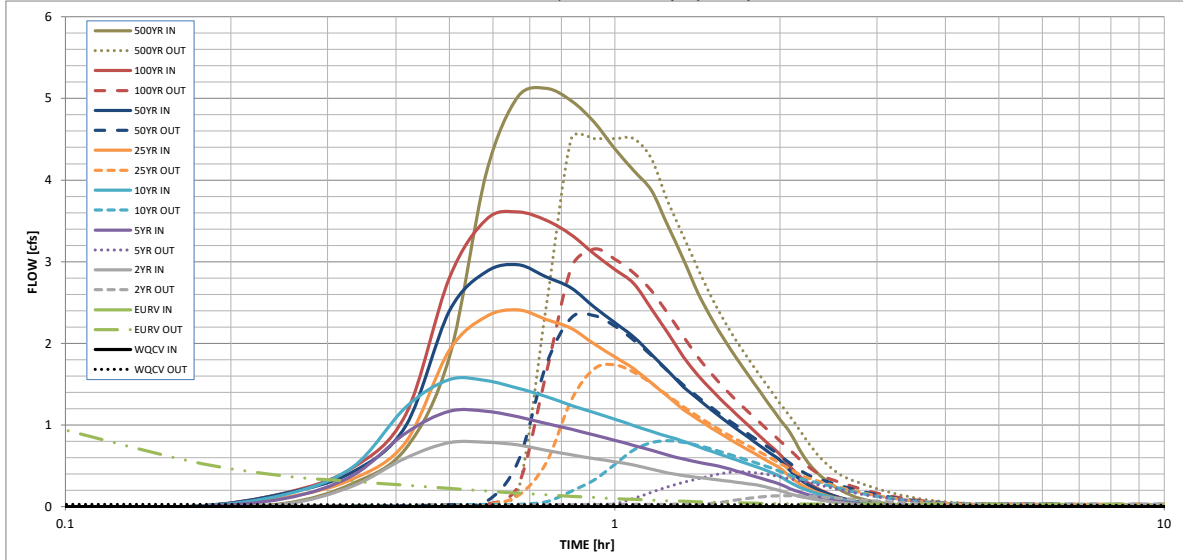
## Routed Hydrograph Results

*The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).*

	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
Design Storm Return Period =	N/A	N/A	0.82	1.10	1.34	1.69	1.98	2.29	3.08
One-Hour Rainfall Depth (in) =	0.038	0.112	0.073	0.107	0.143	0.204	0.251	0.307	0.439
CUHP Runoff Volume (acre-ft) =	N/A	N/A	0.073	0.107	0.143	0.204	0.251	0.307	0.439
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.0	0.1	0.3	0.8	1.1	1.5	2.4
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A							
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.01	0.06	0.16	0.42	0.58	0.78	1.23
Peak Inflow Q (cfs) =	N/A	N/A	0.8	1.2	1.6	2.4	3.0	3.6	5.1
Peak Outflow Q (cfs) =	0.0	4.0	0.1	0.4	0.8	1.7	2.3	3.2	4.5
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	3.8	2.6	2.1	2.1	2.1	1.9
Structure Controlling Flow =	Plate	Spillway	Overflow Weir 1	Spillway	Spillway	Spillway	Spillway	Spillway	N/A
Max Velocity through Gate 1 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Max Velocity through Gate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	37	40	44	42	39	36	33	31	27
Time to Drain 99% of Inflow Volume (hours) =	40	46	49	48	47	45	44	42	39
Maximum Ponding Depth (ft) =	1.40	2.28	1.92	2.13	2.23	2.37	2.43	2.50	2.60
Area at Maximum Ponding Depth (acres) =	0.04	0.06	0.05	0.05	0.06	0.06	0.06	0.06	0.06
Maximum Volume Stored (acre-ft) =	0.038	0.080	0.061	0.072	0.078	0.085	0.090	0.094	0.100
WSE =	5847.30	5848.18	5847.82	5848.03	5848.13	5848.27	5848.33	5848.40	5848.50

# DETENTION BASIN OUTLET STRUCTURE DESIGN

*MHFD-Detention, Version 4.06 (July 2022)*



S-A-V-D Chart Axis Override	X-axis	Left Y-Axis	Right Y-Axis
minimum bound			
maximum bound			

# MHFD CULVERT ANALYSIS

Please match the Storm Line Profile Name and appropriate Pipe ID to those shown in the Construction Documents for clear comparison.

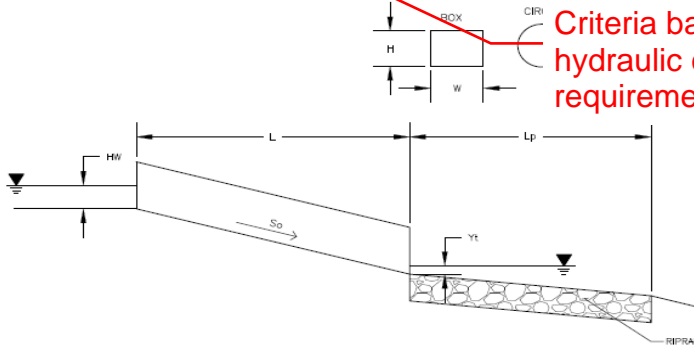
## DETERMINATION OF CULVERT HEADWATER AND OUTLET PROTECTION

*MHFD-Culvert, Version 4.00 (May 2020)*

**Project:** Salisbury Park North Phase 1

**ID:** Bypass 2 Year

See Section 6.4.2 of the Parker SDECM for Culvert Sizing Criteria based on the 10-Year frequency storm and provide hydraulic calculations confirming these culvert sizing requirements are met. (TYP)



**Soil Type:**

Choose One:

- Sandy  
 Non-Sandy

**Design Information:**

Design Discharge

Q = 15 cfs

Circular Culvert:

Barrel Diameter in Inches

D = 36 inches  
 Grooved Edge Projecting

The bypass culvert calculations do not match parameters shown in the construction documents that shows a 30-inch pipe with invert in of 5845.15. Please provide and ensure all culvert calculations correspond to the proposed construction set. Please provide profiles with the calculations that match the profiles in the construction set. (recommend utilizing HY-8 for culvert calcs)

OR

H (Rise) = \_\_\_\_\_ ft  
 W (Span) = \_\_\_\_\_ ft

# Barrels = 2  
 Elev IN = 5850.15 ft  
 Elev OUT = 5847.11 ft  
 L = 1045 ft  
 n = 0.013  
 $k_b$  = 1.32  
 $k_x$  = 1  
 $Y_t$ , Elevation = \_\_\_\_\_ ft  
 V = 5 ft/s

Max Allowable Channel Velocity

**Calculated Results:**

Culvert Cross Sectional Area Available  
 Culvert Normal Depth  
 Culvert Critical Depth  
 Froude Number  
 Entrance Loss Coefficient  
 Friction Loss Coefficient  
 Sum of All Loss Coefficients

A = 7.07 ft<sup>2</sup>  
 $Y_n$  = 0.93 ft  
 $Y_c$  = 0.86 ft  
 Fr = 0.87  
 $k_e$  = 0.20  
 $k_f$  = 7.52  
 $k_s$  = 10.04 ft

Headwater:

Inlet Control Headwater  
 Outlet Control Headwater

$HW_i$  = 1.17 ft  
 $HW_o$  = N/A ft  
**HW = N/A ft**  
**HW/D = N/A**

**Design Headwater Elevation**  
**Headwater/Diameter OR Headwater/Rise Ratio**

Outlet Control Headwater Approximation Method Inaccurate for Low Flow - Backwater Calculations Required

Outlet Protection:

Flow/(Diameter<sup>2.5</sup>)  
 Tailwater Surface Height  
 Tailwater/Diameter  
 Expansion Factor  
 Flow Area at Max Channel Velocity  
 Width of Equivalent Conduit for Multiple Barrels

$Q/D^{2.5}$  = 0.48 ft<sup>0.5</sup>/s  
 $Y_t$  = 1.20 ft  
 $Y_t/D$  = 0.40  
 $1/(2*\tan(\Theta))$  = 6.70  
 $A_t$  = 3.00 ft<sup>2</sup>  
 $W_{eq}$  = 6.00 ft  
 $L_p$  = 9 ft  
 $T$  = 8 ft

**Length of Riprap Protection**  
**Width of Riprap Protection at Downstream End**

Adjusted Diameter for Supercritical Flow  
 Minimum Theoretical Riprap Size  
 Nominal Riprap Size

Da = - ft  
 $d_{50}$  min = 1 in  
 $d_{50}$  nominal = 6 in  
**Type = VL**

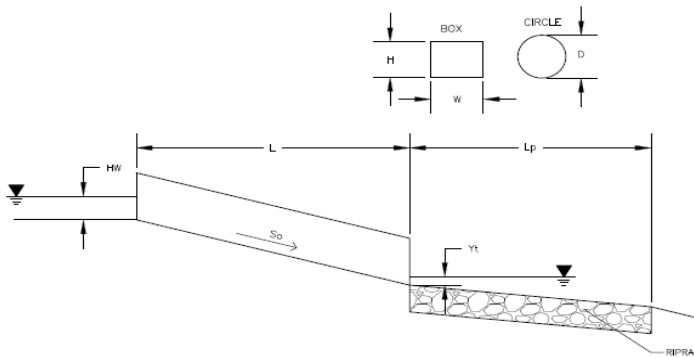
**MHFD Riprap Type**

# DETERMINATION OF CULVERT HEADWATER AND OUTLET PROTECTION

*MHFD-Culvert, Version 4.00 (May 2020)*

**Project:** Salisbury Park North Phase 1

**ID:** Bypass - 100 Year



**Soil Type:**

Choose One:

- Sandy  
 Non-Sandy

**Design Information:**

Design Discharge	Q = <input type="text" value="74"/> cfs
<b>Circular Culvert:</b>	
Barrel Diameter in Inches	D = <input type="text" value="36"/> inches
Inlet Edge Type (Choose from pull-down list)	Grooved Edge Projecting
<b>OR:</b>	
<b>Box Culvert:</b>	
Barrel Height (Rise) in Feet	H (Rise) = <input type="text"/> ft
Barrel Width (Span) in Feet	W (Span) = <input type="text"/> ft
Inlet Edge Type (Choose from pull-down list)	
<b>OR:</b>	
Number of Barrels	# Barrels = <input type="text" value="2"/>
Inlet Elevation	Elev IN = <input type="text" value="5850.15"/> ft
Outlet Elevation <b>OR</b> Slope	Elev OUT = <input type="text" value="5847.11"/> ft
Culvert Length	L = <input type="text" value="1045"/> ft
Manning's Roughness	n = <input type="text" value="0.013"/>
Bend Loss Coefficient	k <sub>b</sub> = <input type="text" value="1.32"/>
Exit Loss Coefficient	k <sub>x</sub> = <input type="text" value="1"/>
Tailwater Surface Elevation	Y <sub>t</sub> , Elevation = <input type="text"/> ft
Max Allowable Channel Velocity	V = <input type="text" value="5"/> ft/s

**Calculated Results:**

Culvert Cross Sectional Area Available	A = <input type="text" value="7.07"/> ft <sup>2</sup>
Culvert Normal Depth	Y <sub>n</sub> = <input type="text" value="2.53"/> ft
Culvert Critical Depth	Y <sub>c</sub> = <input type="text" value="1.98"/> ft
Froude Number	Fr = <input type="text" value="0.60"/>
Entrance Loss Coefficient	k <sub>e</sub> = <input type="text" value="0.20"/>
Friction Loss Coefficient	k <sub>f</sub> = <input type="text" value="7.52"/>
Sum of All Loss Coefficients	k <sub>s</sub> = <input type="text" value="10.04"/> ft
<b>Headwater:</b>	
Inlet Control Headwater	HW <sub>I</sub> = <input type="text" value="2.93"/> ft
Outlet Control Headwater	HW <sub>O</sub> = <input type="text" value="3.72"/> ft
<b>Design Headwater Elevation</b>	<b>HW = <input type="text" value="5853.87"/> ft</b>
<b>Headwater/Diameter <u>OR</u> Headwater/Rise Ratio</b>	<b>HW/D = <input type="text" value="1.24"/></b>
<b>Outlet Protection:</b>	
Flow/(Diameter <sup>2.5</sup> )	Q/D <sup>2.5</sup> = <input type="text" value="2.37"/> ft <sup>0.5</sup> /s
Tailwater Surface Height	Y <sub>t</sub> = <input type="text" value="1.20"/> ft
Tailwater/Diameter	Y <sub>t</sub> /D = <input type="text" value="0.40"/>
Expansion Factor	1/(2*tan(Θ)) = <input type="text" value="5.23"/>
Flow Area at Max Channel Velocity	A <sub>t</sub> = <input type="text" value="14.80"/> ft <sup>2</sup>
Width of Equivalent Conduit for Multiple Barrels	W <sub>eq</sub> = <input type="text" value="6.00"/> ft
<b>Length of Riprap Protection</b>	<b>L<sub>p</sub> = <input type="text" value="30"/> ft</b>
<b>Width of Riprap Protection at Downstream End</b>	<b>T = <input type="text" value="12"/> ft</b>
<b>Adjusted Diameter for Supercritical Flow</b>	
Minimum Theoretical Riprap Size	Da = <input type="text" value="-"/> ft
Nominal Riprap Size	d <sub>50</sub> min = <input type="text" value="6"/> in
<b>MHFD Riprap Type</b>	d <sub>50</sub> nominal = <input type="text" value="6"/> in
	<b>Type = <input type="text" value="VL"/></b>

Please match the Storm Line Profile Name and appropriate Pipe ID to those shown in the Construction Documents for clear comparison.

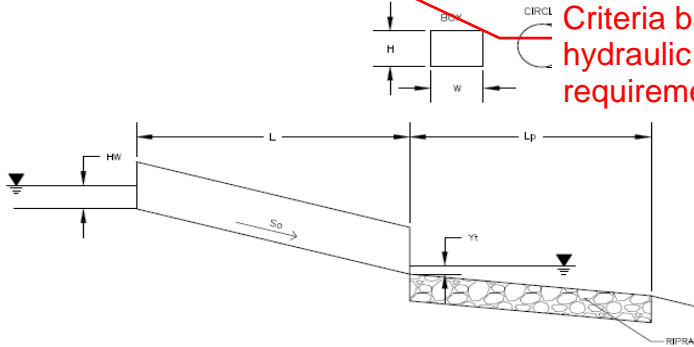
## DETERMINATION OF CULVERT HEADWATER AND OUTLET PROTECTION

*MHFD-Culvert, Version 4.00 (May 2020)*

**Project:** Salisbury Park North Phase 1

**ID:** Bypass 2 - 2 Year

See Section 6.4.2 of the Parker SDECM for Culvert Sizing Criteria based on the 10-Year frequency storm and provide hydraulic calculations confirming these culvert sizing requirements are met. (TYP)



**Soil Type:**

Choose One:

- Sandy  
 Non-Sandy

Supercritical Flow! Using Adjusted Diameter to calculate protection type.

**Design Information:**

Design Discharge

Q = 15 cfs

**Circular Culvert:**

Barrel Diameter in Inches

D = 36 inches  
Grooved Edge Projecting

The bypass culvert calculations do not match parameters shown in the construction documents that shows a 30-inch pipe with invert in of 5845.15. Please provide and ensure all culvert calculations correspond to the proposed construction set. Please provide profiles with the calculations that match the profiles in the construction set. (recommend utilizing HY-8 for culvert calcs)

**OR**  
H (Rise) = \_\_\_\_\_ ft  
W (Span) = \_\_\_\_\_ ft

# Barrels = 2  
Elev IN = 5845.15 ft  
Elev OUT = 5843.63 ft  
L = 160 ft  
n = 0.013  
 $k_b$  = 1.32  
 $k_x$  = 1  
 $Y_t$ , Elevation = \_\_\_\_\_ ft  
V = 5 ft/s

Tailwater Surface Elevation  
Max Allowable Channel Velocity

**Calculated Results:**

Culvert Cross Sectional Area Available  
Culvert Normal Depth  
Culvert Critical Depth  
Froude Number  
Entrance Loss Coefficient  
Friction Loss Coefficient  
Sum of All Loss Coefficients

A = 7.07 ft<sup>2</sup>  
 $Y_n$  = 0.69 ft  
 $Y_c$  = 0.86 ft  
Fr = 1.56 **Supercritical!**  
 $k_e$  = 0.20  
 $k_f$  = 1.15  
 $k_s$  = 3.67 ft

**Headwater:**

Inlet Control Headwater  
Outlet Control Headwater  
**Design Headwater Elevation**  
**Headwater/Diameter OR Headwater/Rise Ratio**

$HW_i$  = 1.17 ft  
 $HW_o$  = N/A ft  
**HW = N/A ft**  
**HW/D = N/A**

Outlet Control Headwater Approximation Method Inaccurate for Low Flow - Backwater Calculations Required

**Outlet Protection:**

Flow/(Diameter<sup>2.5</sup>)  
Tailwater Surface Height  
Tailwater/Diameter  
Expansion Factor  
Flow Area at Max Channel Velocity  
Width of Equivalent Conduit for Multiple Barrels  
**Length of Riprap Protection**  
**Width of Riprap Protection at Downstream End**

$Q/D^{2.5}$  = 0.48 ft<sup>0.5</sup>/s  
 $Y_t$  = 1.20 ft  
 $Y_t/D$  = 0.40  
 $1/(2*\tan(\theta))$  = 6.70  
 $A_t$  = 3.00 ft<sup>2</sup>  
 $W_{eq}$  = 6.00 ft  
 $L_p$  = 9 ft  
**T = 8 ft**

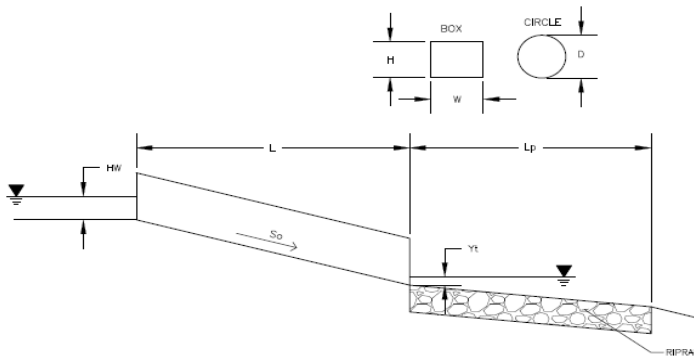
Adjusted Diameter for Supercritical Flow  
Minimum Theoretical Riprap Size  
Nominal Riprap Size  
**MHFD Riprap Type**

Da = 1.84 ft  
 $d_{50}$  min = 1 in  
 $d_{50}$  nominal = 6 in  
**Type = VL**

# DETERMINATION OF CULVERT HEADWATER AND OUTLET PROTECTION

*MHFD-Culvert, Version 4.00 (May 2020)*

**Project:** Salisbury Park North Phase 1  
**ID:** Bypass 2 - 100 Year



**Soil Type:**  
 Choose One:  
 Sandy  
 Non-Sandy

**Supercritical Flow! Using Adjusted Diameter to calculate protection type.**

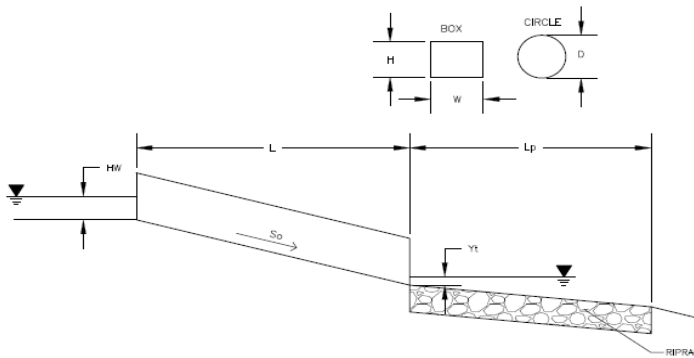
Design Information:	
Design Discharge	Q = <input style="width: 100px;" type="text" value="74"/> cfs
<b>Circular Culvert:</b>	
Barrel Diameter in Inches	D = <input style="width: 100px;" type="text" value="36"/> inches
Inlet Edge Type (Choose from pull-down list)	Grooved Edge Projecting
<b>OR:</b>	
<b>Box Culvert:</b>	
Barrel Height (Rise) in Feet	H (Rise) = <input style="width: 100px;" type="text"/>
Barrel Width (Span) in Feet	W (Span) = <input style="width: 100px;" type="text"/>
Inlet Edge Type (Choose from pull-down list)	<b>OR</b>
Number of Barrels	# Barrels = <input style="width: 100px;" type="text" value="2"/>
Inlet Elevation	Elev IN = <input style="width: 100px;" type="text" value="5845.15"/> ft
Outlet Elevation <b>OR</b> Slope	Elev OUT = <input style="width: 100px;" type="text" value="5843.63"/> ft
Culvert Length	L = <input style="width: 100px;" type="text" value="160"/> ft
Manning's Roughness	n = <input style="width: 100px;" type="text" value="0.013"/>
Bend Loss Coefficient	k <sub>b</sub> = <input style="width: 100px;" type="text" value="1.32"/>
Exit Loss Coefficient	k <sub>x</sub> = <input style="width: 100px;" type="text" value="1"/>
Tailwater Surface Elevation	Y <sub>t</sub> , Elevation = <input style="width: 100px;" type="text"/>
Max Allowable Channel Velocity	V = <input style="width: 100px;" type="text" value="5"/> ft/s
Calculated Results:	
Culvert Cross Sectional Area Available	A = <input style="width: 100px;" type="text" value="7.07"/> ft <sup>2</sup>
Culvert Normal Depth	Y <sub>n</sub> = <input style="width: 100px;" type="text" value="1.62"/> ft
Culvert Critical Depth	Y <sub>c</sub> = <input style="width: 100px;" type="text" value="1.98"/> ft
Froude Number	Fr = <input style="width: 100px;" type="text" value="1.47"/> <b>Supercritical!</b>
Entrance Loss Coefficient	k <sub>e</sub> = <input style="width: 100px;" type="text" value="0.20"/>
Friction Loss Coefficient	k <sub>f</sub> = <input style="width: 100px;" type="text" value="1.15"/>
Sum of All Loss Coefficients	k <sub>s</sub> = <input style="width: 100px;" type="text" value="3.67"/> ft
<b>Headwater:</b>	
Inlet Control Headwater	HW <sub>i</sub> = <input style="width: 100px;" type="text" value="2.92"/> ft
Outlet Control Headwater	HW <sub>o</sub> = <input style="width: 100px;" type="text" value="2.53"/> ft
<b>Design Headwater Elevation</b>	<b>HW = <input style="width: 100px;" type="text" value="5848.07"/> ft</b>
<b>Headwater/Diameter <b>OR</b> Headwater/Rise Ratio</b>	<b>HW/D = <input style="width: 100px;" type="text" value="0.97"/></b>
<b>Outlet Protection:</b>	
Flow/(Diameter <sup>2.5</sup> )	Q/D <sup>2.5</sup> = <input style="width: 100px;" type="text" value="2.37"/> ft <sup>0.5</sup> /s
Tailwater Surface Height	Y <sub>t</sub> = <input style="width: 100px;" type="text" value="1.20"/> ft
Tailwater/Diameter	Y <sub>t</sub> /D = <input style="width: 100px;" type="text" value="0.40"/>
Expansion Factor	1/(2*tan(θ)) = <input style="width: 100px;" type="text" value="5.23"/>
Flow Area at Max Channel Velocity	A <sub>t</sub> = <input style="width: 100px;" type="text" value="14.80"/> ft <sup>2</sup>
Width of Equivalent Conduit for Multiple Barrels	W <sub>eq</sub> = <input style="width: 100px;" type="text" value="6.00"/> ft
<b>Length of Riprap Protection</b>	<b>L<sub>p</sub> = <input style="width: 100px;" type="text" value="30"/> ft</b>
<b>Width of Riprap Protection at Downstream End</b>	<b>T = <input style="width: 100px;" type="text" value="12"/> ft</b>
<b>Adjusted Diameter for Supercritical Flow</b>	
Minimum Theoretical Riprap Size	Da = <input style="width: 100px;" type="text" value="2.31"/> ft
Nominal Riprap Size	d <sub>50</sub> min = <input style="width: 100px;" type="text" value="6"/> in
<b>MHFD Riprap Type</b>	d <sub>50</sub> nominal = <input style="width: 100px;" type="text" value="9"/> in
	<b>Type = <input style="width: 100px;" type="text" value="L"/></b>

# DETERMINATION OF CULVERT HEADWATER AND OUTLET PROTECTION

*MHFD-Culvert, Version 4.00 (May 2020)*

**Project:** Salisbury Park North Phase 1

**ID:** DP2 - Basin A2 Culvert (Upstream) - 5 Year



**Soil Type:**

Choose One:

- Sandy  
 Non-Sandy

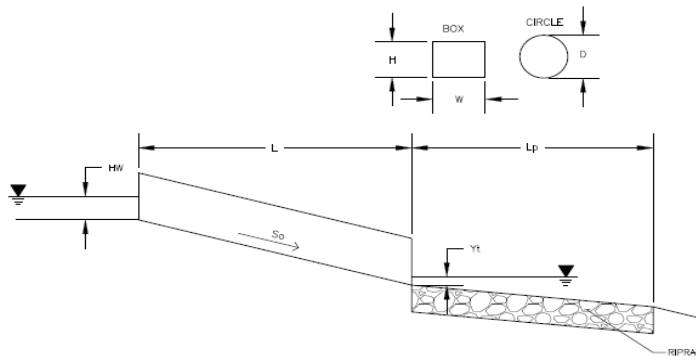
**Supercritical Flow! Using Adjusted Diameter to calculate protection type.**

Design Information:	
Design Discharge	Q = <input type="text" value="0.31"/> cfs
<b>Circular Culvert:</b>	
Barrel Diameter in Inches	D = <input type="text" value="18"/> inches
Inlet Edge Type (Choose from pull-down list)	Square Edge with Headwall
<b>OR:</b>	
<b>Box Culvert:</b>	
Barrel Height (Rise) in Feet	H (Rise) = <input type="text"/> ft
Barrel Width (Span) in Feet	W (Span) = <input type="text"/> ft
Inlet Edge Type (Choose from pull-down list)	
Number of Barrels	# Barrels = <input type="text" value="1"/>
Inlet Elevation	Elev IN = <input type="text" value="5848.77"/> ft
Outlet Elevation <b>OR</b> Slope	Elev OUT = <input type="text" value="4848.63"/> ft
Culvert Length	L = <input type="text" value="31"/> ft
Manning's Roughness	n = <input type="text" value="0.013"/>
Bend Loss Coefficient	k <sub>b</sub> = <input type="text" value="0"/>
Exit Loss Coefficient	k <sub>x</sub> = <input type="text" value="1"/>
Tailwater Surface Elevation	Y <sub>t</sub> , Elevation = <input type="text"/> ft
Max Allowable Channel Velocity	V = <input type="text" value="5"/> ft/s
Calculated Results:	
Culvert Cross Sectional Area Available	A = <input type="text" value="1.77"/> ft <sup>2</sup>
Culvert Normal Depth	Y <sub>n</sub> = <input type="text" value="0.03"/> ft
Culvert Critical Depth	Y <sub>c</sub> = <input type="text" value="0.21"/> ft
Froude Number	Fr = <input type="text" value="58.16"/> <span style="color: red; font-weight: bold;">Supercritical!</span>
Entrance Loss Coefficient	k <sub>e</sub> = <input type="text" value="0.50"/>
Friction Loss Coefficient	k <sub>f</sub> = <input type="text" value="0.56"/>
Sum of All Loss Coefficients	k <sub>s</sub> = <input type="text" value="2.06"/> ft
<b>Headwater:</b>	
Inlet Control Headwater	HW <sub>I</sub> = <input type="text" value="0.19"/> ft
Outlet Control Headwater	HW <sub>O</sub> = <input type="text" value="N/A"/> ft
<b>Design Headwater Elevation</b>	<b>HW = <input type="text" value="N/A"/> ft</b>
<b>Headwater/Diameter <b>OR</b> Headwater/Rise Ratio</b>	<b>HW/D = <input type="text" value="N/A"/></b>
Outlet Control Headwater Approximation Method Inaccurate for Low Flow - Backwater Calculations Required	
<b>Outlet Protection:</b>	
Flow/(Diameter <sup>2.5</sup> )	Q/D <sup>2.5</sup> = <input type="text" value="0.11"/> ft <sup>0.5</sup> /s
Tailwater Surface Height	Y <sub>t</sub> = <input type="text" value="0.60"/> ft
Tailwater/Diameter	Y <sub>t</sub> /D = <input type="text" value="0.40"/>
Expansion Factor	1/(2*tan(Θ)) = <input type="text" value="6.70"/>
Flow Area at Max Channel Velocity	A <sub>t</sub> = <input type="text" value="0.06"/> ft <sup>2</sup>
Width of Equivalent Conduit for Multiple Barrels	W <sub>eq</sub> = <input type="text" value="-"/> ft
<b>Length of Riprap Protection</b>	<b>L<sub>p</sub> = <input type="text" value="5"/> ft</b>
<b>Width of Riprap Protection at Downstream End</b>	<b>T = <input type="text" value="3"/> ft</b>
<b>Adjusted Diameter for Supercritical Flow</b>	
Minimum Theoretical Riprap Size	d <sub>50 min</sub> = <input type="text" value="0"/> in
Nominal Riprap Size	d <sub>50 nominal</sub> = <input type="text" value="6"/> in
<b>MHFD Riprap Type</b>	<b>Type = <input type="text" value="VL"/></b>

# DETERMINATION OF CULVERT HEADWATER AND OUTLET PROTECTION

*MHFD-Culvert, Version 4.00 (May 2020)*

**Project:** Salisbury Park North Phase 1  
**ID:** DP2 - Basin A2 Culvert (Upstream) - 100 Year



**Soil Type:**  
 Choose One:  
 Sandy  
 Non-Sandy

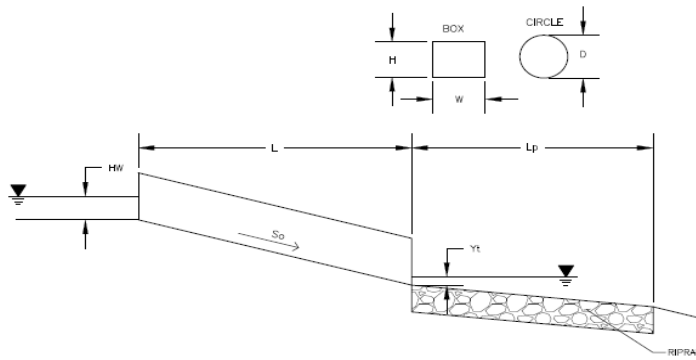
**Supercritical Flow! Using Adjusted Diameter to calculate protection type.**

Design Information:	
Design Discharge	Q = <input type="text" value="1.27"/> cfs
<b>Circular Culvert:</b>	
Barrel Diameter in Inches	D = <input type="text" value="18"/> inches
Inlet Edge Type (Choose from pull-down list)	Square Edge with Headwall
<b>OR:</b>	
<b>Box Culvert:</b>	
Barrel Height (Rise) in Feet	H (Rise) = <input type="text"/> ft
Barrel Width (Span) in Feet	W (Span) = <input type="text"/> ft
Inlet Edge Type (Choose from pull-down list)	
Number of Barrels	# Barrels = <input type="text" value="1"/>
Inlet Elevation	Elev IN = <input type="text" value="5848.77"/> ft
Outlet Elevation <b>OR</b> Slope	Elev OUT = <input type="text" value="4848.63"/> ft
Culvert Length	L = <input type="text" value="31"/> ft
Manning's Roughness	n = <input type="text" value="0.013"/>
Bend Loss Coefficient	k <sub>b</sub> = <input type="text" value="0"/>
Exit Loss Coefficient	k <sub>x</sub> = <input type="text" value="1"/>
Tailwater Surface Elevation	Y <sub>t</sub> , Elevation = <input type="text"/> ft
Max Allowable Channel Velocity	V = <input type="text" value="5"/> ft/s
Calculated Results:	
Culvert Cross Sectional Area Available	A = <input type="text" value="1.77"/> ft <sup>2</sup>
Culvert Normal Depth	Y <sub>n</sub> = <input type="text" value="0.05"/> ft
Culvert Critical Depth	Y <sub>c</sub> = <input type="text" value="0.42"/> ft
Froude Number	Fr = <input type="text" value="64.43"/> <span style="color: red;">Supercritical!</span>
Entrance Loss Coefficient	k <sub>e</sub> = <input type="text" value="0.50"/>
Friction Loss Coefficient	k <sub>f</sub> = <input type="text" value="0.56"/>
Sum of All Loss Coefficients	k <sub>s</sub> = <input type="text" value="2.06"/> ft
<b>Headwater:</b>	
Inlet Control Headwater	HW <sub>I</sub> = <input type="text" value="0.40"/> ft
Outlet Control Headwater	HW <sub>O</sub> = <input type="text" value="N/A"/> ft
<b>Design Headwater Elevation</b>	<b>HW = <input type="text" value="N/A"/> ft</b>
<b>Headwater/Diameter OR Headwater/Rise Ratio</b>	<b>HW/D = <input type="text" value="N/A"/></b>
<b>Outlet Control Headwater Approximation Method Inaccurate for Low Flow - Backwater Calculations Required</b>	
<b>Outlet Protection:</b>	
Flow/(Diameter <sup>2.5</sup> )	Q/D <sup>2.5</sup> = <input type="text" value="0.46"/> ft <sup>0.5</sup> /s
Tailwater Surface Height	Y <sub>t</sub> = <input type="text" value="0.60"/> ft
Tailwater/Diameter	Y <sub>t</sub> /D = <input type="text" value="0.40"/>
Expansion Factor	1/(2*tan(Θ)) = <input type="text" value="6.70"/>
Flow Area at Max Channel Velocity	A <sub>t</sub> = <input type="text" value="0.25"/> ft <sup>2</sup>
Width of Equivalent Conduit for Multiple Barrels	W <sub>eq</sub> = <input type="text" value="-"/> ft
<b>Length of Riprap Protection</b>	<b>L<sub>p</sub> = <input type="text" value="5"/> ft</b>
<b>Width of Riprap Protection at Downstream End</b>	<b>T = <input type="text" value="3"/> ft</b>
Adjusted Diameter for Supercritical Flow	Da = <input type="text" value="0.78"/> ft
Minimum Theoretical Riprap Size	d <sub>50 min</sub> = <input type="text" value="1"/> in
Nominal Riprap Size	d <sub>50 nominal</sub> = <input type="text" value="6"/> in
<b>MHFD Riprap Type</b>	<b>Type = <input type="text" value="VL"/></b>

# DETERMINATION OF CULVERT HEADWATER AND OUTLET PROTECTION

*MHFD-Culvert, Version 4.00 (May 2020)*

**Project:** Salisbury Park North Phase 1  
**ID:** DP2 - Basin A2 Culvert (Downstream) - 5 Year



**Soil Type:**  
 Choose One:  
 Sandy  
 Non-Sandy

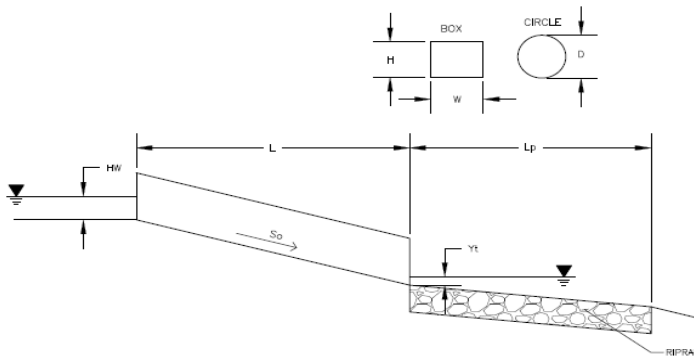
**Supercritical Flow! Using Adjusted Diameter to calculate protection type.**

Design Information:	
Design Discharge	Q = <input type="text" value="1.75"/> cfs
<b>Circular Culvert:</b>	
Barrel Diameter in Inches	D = <input type="text" value="18"/> inches
Inlet Edge Type (Choose from pull-down list)	Square Edge with Headwall
<b>OR:</b>	
<b>Box Culvert:</b>	
Barrel Height (Rise) in Feet	H (Rise) = <input type="text"/> ft
Barrel Width (Span) in Feet	W (Span) = <input type="text"/> ft
Inlet Edge Type (Choose from pull-down list)	
Number of Barrels	# Barrels = <input type="text" value="1"/>
Inlet Elevation	Elev IN = <input type="text" value="5846.52"/> ft
Outlet Elevation <b>OR</b> Slope	Elev OUT = <input type="text" value="4845.88"/> ft
Culvert Length	L = <input type="text" value="180"/> ft
Manning's Roughness	n = <input type="text" value="0.013"/>
Bend Loss Coefficient	k <sub>b</sub> = <input type="text" value="0"/>
Exit Loss Coefficient	k <sub>x</sub> = <input type="text" value="1"/>
Tailwater Surface Elevation	Y <sub>t</sub> , Elevation = <input type="text"/> ft
Max Allowable Channel Velocity	V = <input type="text" value="5"/> ft/s
Calculated Results:	
Culvert Cross Sectional Area Available	A = <input type="text" value="1.77"/> ft <sup>2</sup>
Culvert Normal Depth	Y <sub>n</sub> = <input type="text" value="0.09"/> ft
Culvert Critical Depth	Y <sub>c</sub> = <input type="text" value="0.50"/> ft
Froude Number	Fr = <input type="text" value="29.04"/> <b>Supercritical!</b>
Entrance Loss Coefficient	k <sub>e</sub> = <input type="text" value="0.50"/>
Friction Loss Coefficient	k <sub>f</sub> = <input type="text" value="3.26"/>
Sum of All Loss Coefficients	k <sub>s</sub> = <input type="text" value="4.76"/> ft
<b>Headwater:</b>	
Inlet Control Headwater	HW <sub>I</sub> = <input type="text" value="0.41"/> ft
Outlet Control Headwater	HW <sub>O</sub> = <input type="text" value="N/A"/> ft
<b>Design Headwater Elevation</b>	<b>HW = <input type="text" value="N/A"/> ft</b>
<b>Headwater/Diameter OR Headwater/Rise Ratio</b>	<b>HW/D = <input type="text" value="N/A"/></b>
<b>Outlet Control Headwater Approximation Method Inaccurate for Low Flow - Backwater Calculations Required</b>	
<b>Outlet Protection:</b>	
Flow/(Diameter <sup>2.5</sup> )	Q/D <sup>2.5</sup> = <input type="text" value="0.64"/> ft <sup>0.5</sup> /s
Tailwater Surface Height	Y <sub>t</sub> = <input type="text" value="0.60"/> ft
Tailwater/Diameter	Y <sub>t</sub> /D = <input type="text" value="0.40"/>
Expansion Factor	1/(2*tan(Θ)) = <input type="text" value="6.70"/>
Flow Area at Max Channel Velocity	A <sub>t</sub> = <input type="text" value="0.35"/> ft <sup>2</sup>
Width of Equivalent Conduit for Multiple Barrels	W <sub>eq</sub> = <input type="text" value="-"/> ft
<b>Length of Riprap Protection</b>	<b>L<sub>p</sub> = <input type="text" value="5"/> ft</b>
<b>Width of Riprap Protection at Downstream End</b>	<b>T = <input type="text" value="3"/> ft</b>
Adjusted Diameter for Supercritical Flow	Da = <input type="text" value="0.79"/> ft
Minimum Theoretical Riprap Size	d <sub>50</sub> min = <input type="text" value="1"/> in
Nominal Riprap Size	d <sub>50</sub> nominal = <input type="text" value="6"/> in
<b>MHFD Riprap Type</b>	<b>Type = <input type="text" value="VL"/></b>

# DETERMINATION OF CULVERT HEADWATER AND OUTLET PROTECTION

MHFD-Culvert, Version 4.00 (May 2020)

**Project:** Salisbury Park North Phase 1  
**ID:** DP2 - Basin A2 Culvert (Downstream) - 100 Year



**Soil Type:**  
 Choose One:  
 Sandy  
 Non-Sandy

**Supercritical Flow! Using Adjusted Diameter to calculate protection type.**

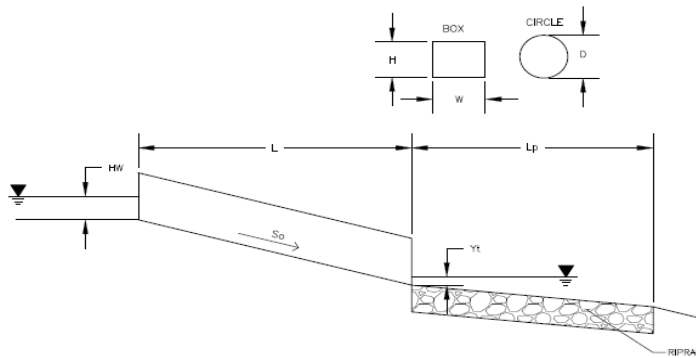
Design Information:	
Design Discharge	Q = <input type="text" value="7.2"/> cfs
<b>Circular Culvert:</b>	
Barrel Diameter in Inches	D = <input type="text" value="18"/> inches
Inlet Edge Type (Choose from pull-down list)	Square Edge with Headwall
<b>OR:</b>	
<b>Box Culvert:</b>	
Barrel Height (Rise) in Feet	H (Rise) = <input type="text"/> ft
Barrel Width (Span) in Feet	W (Span) = <input type="text"/> ft
Inlet Edge Type (Choose from pull-down list)	
Number of Barrels	# Barrels = <input type="text" value="1"/>
Inlet Elevation	Elev IN = <input type="text" value="5846.52"/> ft
Outlet Elevation <b>OR</b> Slope	Elev OUT = <input type="text" value="4845.88"/> ft
Culvert Length	L = <input type="text" value="180"/> ft
Manning's Roughness	n = <input type="text" value="0.013"/>
Bend Loss Coefficient	k <sub>b</sub> = <input type="text" value="0"/>
Exit Loss Coefficient	k <sub>x</sub> = <input type="text" value="1"/>
Tailwater Surface Elevation	Y <sub>t</sub> , Elevation = <input type="text"/> ft
Max Allowable Channel Velocity	V = <input type="text" value="5"/> ft/s
Calculated Results:	
Culvert Cross Sectional Area Available	A = <input type="text" value="1.77"/> ft <sup>2</sup>
Culvert Normal Depth	Y <sub>n</sub> = <input type="text" value="0.18"/> ft
Culvert Critical Depth	Y <sub>c</sub> = <input type="text" value="1.04"/> ft
Froude Number	Fr = <input type="text" value="31.66"/> <span style="color: red;">Supercritical!</span>
Entrance Loss Coefficient	k <sub>e</sub> = <input type="text" value="0.50"/>
Friction Loss Coefficient	k <sub>f</sub> = <input type="text" value="3.26"/>
Sum of All Loss Coefficients	k <sub>s</sub> = <input type="text" value="4.76"/> ft
<b>Headwater:</b>	
Inlet Control Headwater	HW <sub>I</sub> = <input type="text" value="0.83"/> ft
Outlet Control Headwater	HW <sub>O</sub> = <input type="text" value="N/A"/> ft
<b>Design Headwater Elevation</b>	<b>HW</b> = <input type="text" value="N/A"/> ft
<b>Headwater/Diameter OR Headwater/Rise Ratio</b>	<b>HW/D</b> = <input type="text" value="N/A"/>
<b>Outlet Control Headwater Approximation Method Inaccurate for Low Flow - Backwater Calculations Required</b>	
<b>Outlet Protection:</b>	
Flow/(Diameter <sup>2.5</sup> )	Q/D <sup>2.5</sup> = <input type="text" value="2.61"/> ft <sup>0.5</sup> /s
Tailwater Surface Height	Y <sub>t</sub> = <input type="text" value="0.60"/> ft
Tailwater/Diameter	Y <sub>t</sub> /D = <input type="text" value="0.40"/>
Expansion Factor	1/(2*tan(Θ)) = <input type="text" value="4.91"/>
Flow Area at Max Channel Velocity	A <sub>t</sub> = <input type="text" value="1.44"/> ft <sup>2</sup>
Width of Equivalent Conduit for Multiple Barrels	W <sub>eq</sub> = <input type="text" value="-"/> ft
<b>Length of Riprap Protection</b>	<b>L<sub>p</sub></b> = <input type="text" value="5"/> ft
<b>Width of Riprap Protection at Downstream End</b>	<b>T</b> = <input type="text" value="3"/> ft
Adjusted Diameter for Supercritical Flow	Da = <input type="text" value="0.84"/> ft
Minimum Theoretical Riprap Size	d <sub>50 min</sub> = <input type="text" value="4"/> in
Nominal Riprap Size	d <sub>50 nominal</sub> = <input type="text" value="6"/> in
<b>MHFD Riprap Type</b>	<b>Type</b> = <input type="text" value="VL"/>

# DETERMINATION OF CULVERT HEADWATER AND OUTLET PROTECTION

*MHFD-Culvert, Version 4.00 (May 2020)*

**Project:** Salisbury Park North Phase 1

**ID:** DP10 - Basin C3 Culvert (Upstream) - 5 Year



**Soil Type:**

Choose One:

Sandy

Non-Sandy

**Design Information:**

Design Discharge	Q = <input type="text" value="0.36"/> cfs
Circular Culvert:	
Barrel Diameter in Inches	D = <input type="text" value="12"/> inches
Inlet Edge Type (Choose from pull-down list)	Square Edge with Headwall
<b>OR:</b>	
Box Culvert:	
Barrel Height (Rise) in Feet	H (Rise) = <input type="text"/> ft
Barrel Width (Span) in Feet	W (Span) = <input type="text"/> ft
Inlet Edge Type (Choose from pull-down list)	
Number of Barrels	# Barrels = <input type="text" value="1"/>
Inlet Elevation	Elev IN = <input type="text" value="5849.5"/> ft
Outlet Elevation <b>OR</b> Slope	Elev OUT = <input type="text" value="5849.36"/> ft
Culvert Length	L = <input type="text" value="38"/> ft
Manning's Roughness	n = <input type="text" value="0.013"/>
Bend Loss Coefficient	k <sub>b</sub> = <input type="text" value="0"/>
Exit Loss Coefficient	k <sub>x</sub> = <input type="text" value="1"/>
Tailwater Surface Elevation	Y <sub>t</sub> , Elevation = <input type="text"/> ft
Max Allowable Channel Velocity	V = <input type="text" value="5"/> ft/s

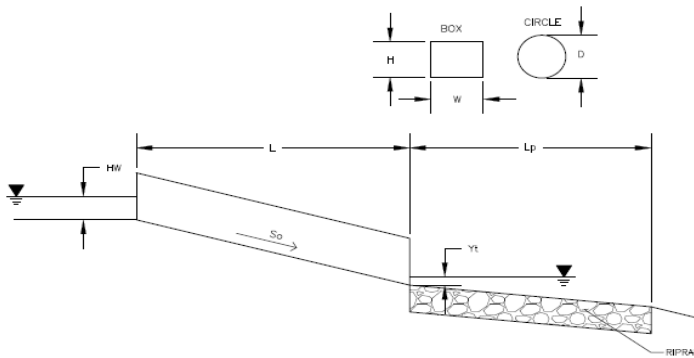
**Calculated Results:**

Culvert Cross Sectional Area Available	A = <input type="text" value="0.79"/> ft <sup>2</sup>
Culvert Normal Depth	Y <sub>n</sub> = <input type="text" value="0.28"/> ft
Culvert Critical Depth	Y <sub>c</sub> = <input type="text" value="0.25"/> ft
Froude Number	Fr = <input type="text" value="0.81"/>
Entrance Loss Coefficient	k <sub>e</sub> = <input type="text" value="0.50"/>
Friction Loss Coefficient	k <sub>f</sub> = <input type="text" value="1.18"/>
Sum of All Loss Coefficients	k <sub>s</sub> = <input type="text" value="2.68"/> ft
Headwater:	
Inlet Control Headwater	HW <sub>I</sub> = <input type="text" value="0.34"/> ft
Outlet Control Headwater	HW <sub>O</sub> = <input type="text" value="N/A"/> ft
<b>Design Headwater Elevation</b>	<b>HW = <input type="text" value="N/A"/> ft</b>
<b>Headwater/Diameter <b>OR</b> Headwater/Rise Ratio</b>	<b>HW/D = <input type="text" value="N/A"/></b>
<b>Outlet Control Headwater Approximation Method Inaccurate for Low Flow - Backwater Calculations Required</b>	
Outlet Protection:	
Flow/(Diameter <sup>2.5</sup> )	Q/D <sup>2.5</sup> = <input type="text" value="0.36"/> ft <sup>0.5</sup> /s
Tailwater Surface Height	Y <sub>t</sub> = <input type="text" value="0.40"/> ft
Tailwater/Diameter	Y <sub>t</sub> /D = <input type="text" value="0.40"/>
Expansion Factor	1/(2*tan(Θ)) = <input type="text" value="6.70"/>
Flow Area at Max Channel Velocity	A <sub>t</sub> = <input type="text" value="0.07"/> ft <sup>2</sup>
Width of Equivalent Conduit for Multiple Barrels	W <sub>eq</sub> = <input type="text" value="-"/> ft
<b>Length of Riprap Protection</b>	<b>L<sub>p</sub> = <input type="text" value="3"/> ft</b>
<b>Width of Riprap Protection at Downstream End</b>	<b>T = <input type="text" value="2"/> ft</b>
Adjusted Diameter for Supercritical Flow	Da = <input type="text" value="-"/> ft
Minimum Theoretical Riprap Size	d <sub>50 min</sub> = <input type="text" value="0"/> in
Nominal Riprap Size	d <sub>50 nominal</sub> = <input type="text" value="6"/> in
<b>MHFD Riprap Type</b>	<b>Type = <input type="text" value="VL"/></b>

# DETERMINATION OF CULVERT HEADWATER AND OUTLET PROTECTION

*MHFD-Culvert, Version 4.00 (May 2020)*

**Project:** Salisbury Park North Phase 1  
**ID:** DP 10 - Basin C3 Culvert (Upstream) - 100 Year



**Soil Type:**

Choose One:

- Sandy  
 Non-Sandy

**Design Information:**

Design Discharge	Q = <input type="text" value="1.47"/> cfs
<b>Circular Culvert:</b>	
Barrel Diameter in Inches	D = <input type="text" value="12"/> inches
Inlet Edge Type (Choose from pull-down list)	Square Edge with Headwall
<b>OR:</b>	
<b>Box Culvert:</b>	
Barrel Height (Rise) in Feet	H (Rise) = <input type="text"/> ft
Barrel Width (Span) in Feet	W (Span) = <input type="text"/> ft
Inlet Edge Type (Choose from pull-down list)	
<b>OR:</b>	
Number of Barrels	# Barrels = <input type="text" value="1"/>
Inlet Elevation	Elev IN = <input type="text" value="5849.5"/> ft
Outlet Elevation <b>OR</b> Slope	Elev OUT = <input type="text" value="5849.36"/> ft
Culvert Length	L = <input type="text" value="38"/> ft
Manning's Roughness	n = <input type="text" value="0.013"/>
Bend Loss Coefficient	k <sub>b</sub> = <input type="text" value="0"/>
Exit Loss Coefficient	k <sub>x</sub> = <input type="text" value="1"/>
Tailwater Surface Elevation	Y <sub>t</sub> , Elevation = <input type="text"/> ft
Max Allowable Channel Velocity	V = <input type="text" value="5"/> ft/s

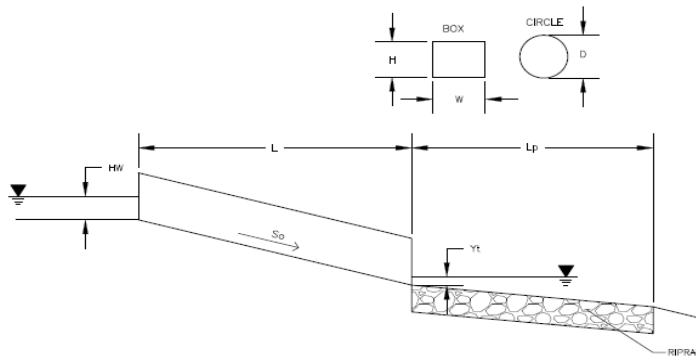
**Calculated Results:**

Culvert Cross Sectional Area Available	A = <input type="text" value="0.79"/> ft <sup>2</sup>
Culvert Normal Depth	Y <sub>n</sub> = <input type="text" value="0.60"/> ft
Culvert Critical Depth	Y <sub>c</sub> = <input type="text" value="0.51"/> ft
Froude Number	Fr = <input type="text" value="0.73"/>
Entrance Loss Coefficient	k <sub>e</sub> = <input type="text" value="0.50"/>
Friction Loss Coefficient	k <sub>f</sub> = <input type="text" value="1.18"/>
Sum of All Loss Coefficients	k <sub>s</sub> = <input type="text" value="2.68"/> ft
<b>Headwater:</b>	
Inlet Control Headwater	HW <sub>I</sub> = <input type="text" value="0.76"/> ft
Outlet Control Headwater	HW <sub>O</sub> = <input type="text" value="0.76"/> ft
<b>Design Headwater Elevation</b>	<b>HW = <input type="text" value="5850.26"/> ft</b>
<b>Headwater/Diameter OR Headwater/Rise Ratio</b>	<b>HW/D = <input type="text" value="0.76"/></b>
<b>Outlet Protection:</b>	
Flow/(Diameter <sup>2.5</sup> )	Q/D <sup>2.5</sup> = <input type="text" value="1.47"/> ft <sup>0.5</sup> /s
Tailwater Surface Height	Y <sub>t</sub> = <input type="text" value="0.40"/> ft
Tailwater/Diameter	Y <sub>t</sub> /D = <input type="text" value="0.40"/>
Expansion Factor	1/(2*tan(Θ)) = <input type="text" value="6.25"/>
Flow Area at Max Channel Velocity	A <sub>t</sub> = <input type="text" value="0.29"/> ft <sup>2</sup>
Width of Equivalent Conduit for Multiple Barrels	W <sub>eq</sub> = <input type="text" value="-"/> ft
<b>Length of Riprap Protection</b>	<b>L<sub>p</sub> = <input type="text" value="3"/> ft</b>
<b>Width of Riprap Protection at Downstream End</b>	<b>T = <input type="text" value="2"/> ft</b>
<b>Adjusted Diameter for Supercritical Flow</b>	
Minimum Theoretical Riprap Size	Da = <input type="text" value="-"/> ft
Nominal Riprap Size	d <sub>50 min</sub> = <input type="text" value="1"/> in
<b>MHFD Riprap Type</b>	<b>d<sub>50 nominal</sub> = <input type="text" value="6"/> in</b>
	<b>Type = <input type="text" value="VL"/></b>

# DETERMINATION OF CULVERT HEADWATER AND OUTLET PROTECTION

MHFD-Culvert, Version 4.00 (May 2020)

**Project:** Salisbury Park North Phase 1  
**ID:** DP10 - Basin C3 Culvert (Downstream) - 5 Year



**Soil Type:**

Choose One:

- Sandy  
 Non-Sandy

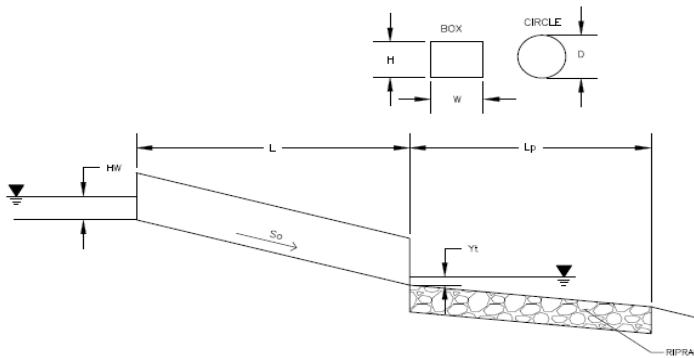
**Supercritical Flow! Using Adjusted Diameter to calculate protection type.**

Design Information:	
Design Discharge	Q = <input type="text" value="2.03"/> cfs
<b>Circular Culvert:</b>	
Barrel Diameter in Inches	D = <input type="text" value="24"/> inches
Inlet Edge Type (Choose from pull-down list)	Square Edge with Headwall
<b>OR:</b>	
<b>Box Culvert:</b>	
Barrel Height (Rise) in Feet	H (Rise) = <input type="text"/> ft
Barrel Width (Span) in Feet	W (Span) = <input type="text"/> ft
Inlet Edge Type (Choose from pull-down list)	
Number of Barrels	# Barrels = <input type="text" value="1"/>
Inlet Elevation	Elev IN = <input type="text" value="5847.01"/> ft
Outlet Elevation <b>OR</b> Slope	Elev OUT = <input type="text" value="4846.4"/> ft
Culvert Length	L = <input type="text" value="123"/> ft
Manning's Roughness	n = <input type="text" value="0.013"/>
Bend Loss Coefficient	k <sub>b</sub> = <input type="text" value="0"/>
Exit Loss Coefficient	k <sub>x</sub> = <input type="text" value="1"/>
Tailwater Surface Elevation	Y <sub>t</sub> , Elevation = <input type="text"/> ft
Max Allowable Channel Velocity	V = <input type="text" value="5"/> ft/s
Calculated Results:	
Culvert Cross Sectional Area Available	A = <input type="text" value="3.14"/> ft <sup>2</sup>
Culvert Normal Depth	Y <sub>n</sub> = <input type="text" value="0.08"/> ft
Culvert Critical Depth	Y <sub>c</sub> = <input type="text" value="0.49"/> ft
Froude Number	Fr = <input type="text" value="34.88"/> <span style="color: red; font-weight: bold;">Supercritical!</span>
Entrance Loss Coefficient	k <sub>e</sub> = <input type="text" value="0.50"/>
Friction Loss Coefficient	k <sub>f</sub> = <input type="text" value="1.52"/>
Sum of All Loss Coefficients	k <sub>s</sub> = <input type="text" value="3.02"/> ft
<b>Headwater:</b>	
Inlet Control Headwater	HW <sub>I</sub> = <input type="text" value="0.43"/> ft
Outlet Control Headwater	HW <sub>O</sub> = <input type="text" value="N/A"/> ft
<b>Design Headwater Elevation</b>	<b>HW = <input type="text" value="N/A"/> ft</b>
<b>Headwater/Diameter <b>OR</b> Headwater/Rise Ratio</b>	<b>HW/D = <input type="text" value="N/A"/></b>
Outlet Control Headwater Approximation Method Inaccurate for Low Flow - Backwater Calculations Required	
<b>Outlet Protection:</b>	
Flow/(Diameter <sup>2.5</sup> )	Q/D <sup>2.5</sup> = <input type="text" value="0.36"/> ft <sup>0.5</sup> /s
Tailwater Surface Height	Y <sub>t</sub> = <input type="text" value="0.80"/> ft
Tailwater/Diameter	Y <sub>t</sub> /D = <input type="text" value="0.40"/>
Expansion Factor	1/(2*tan(θ)) = <input type="text" value="6.70"/>
Flow Area at Max Channel Velocity	A <sub>t</sub> = <input type="text" value="0.41"/> ft <sup>2</sup>
Width of Equivalent Conduit for Multiple Barrels	W <sub>eq</sub> = <input type="text" value="-"/> ft
<b>Length of Riprap Protection</b>	<b>L<sub>p</sub> = <input type="text" value="6"/> ft</b>
<b>Width of Riprap Protection at Downstream End</b>	<b>T = <input type="text" value="3"/> ft</b>
Adjusted Diameter for Supercritical Flow	Da = <input type="text" value="1.04"/> ft
Minimum Theoretical Riprap Size	d <sub>50</sub> min = <input type="text" value="1"/> in
Nominal Riprap Size	d <sub>50</sub> nominal = <input type="text" value="6"/> in
<b>MHFD Riprap Type</b>	<b>Type = <input type="text" value="VL"/></b>

# DETERMINATION OF CULVERT HEADWATER AND OUTLET PROTECTION

*MHFD-Culvert, Version 4.00 (May 2020)*

**Project:** Salisbury Park North Phase 1  
**ID:** DP10 - Basin C3 Culvert (Downstream) - 100 Year



**Soil Type:**  
 Choose One:  
 Sandy  
 Non-Sandy

**Supercritical Flow! Using Adjusted Diameter to calculate protection type.**

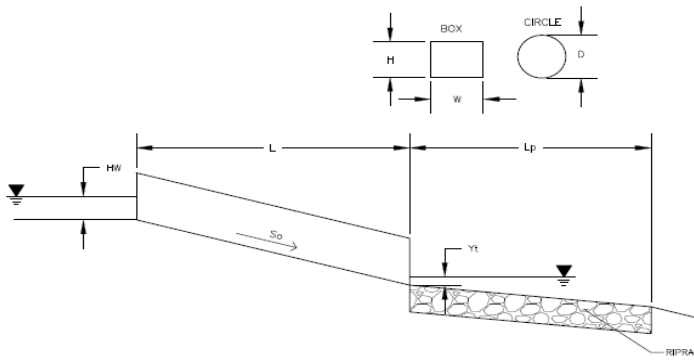
Design Information:	
Design Discharge	Q = <input type="text" value="8.33"/> cfs
<b>Circular Culvert:</b>	
Barrel Diameter in Inches	D = <input type="text" value="24"/> inches
Inlet Edge Type (Choose from pull-down list)	Square Edge with Headwall
<b>OR:</b>	
<b>Box Culvert:</b>	
Barrel Height (Rise) in Feet	H (Rise) = <input type="text"/> ft
Barrel Width (Span) in Feet	W (Span) = <input type="text"/> ft
Inlet Edge Type (Choose from pull-down list)	
Number of Barrels	# Barrels = <input type="text" value="1"/>
Inlet Elevation	Elev IN = <input type="text" value="5847.01"/> ft
Outlet Elevation <b>OR</b> Slope	Elev OUT = <input type="text" value="4846.4"/> ft
Culvert Length	L = <input type="text" value="123"/> ft
Manning's Roughness	n = <input type="text" value="0.013"/>
Bend Loss Coefficient	k <sub>b</sub> = <input type="text" value="0"/>
Exit Loss Coefficient	k <sub>x</sub> = <input type="text" value="1"/>
Tailwater Surface Elevation	Y <sub>t</sub> , Elevation = <input type="text"/> ft
Max Allowable Channel Velocity	V = <input type="text" value="5"/> ft/s
Calculated Results:	
Culvert Cross Sectional Area Available	A = <input type="text" value="3.14"/> ft <sup>2</sup>
Culvert Normal Depth	Y <sub>n</sub> = <input type="text" value="0.16"/> ft
Culvert Critical Depth	Y <sub>c</sub> = <input type="text" value="1.03"/> ft
Froude Number	Fr = <input type="text" value="38.31"/> <span style="color: red; font-weight: bold;">Supercritical!</span>
Entrance Loss Coefficient	k <sub>e</sub> = <input type="text" value="0.50"/>
Friction Loss Coefficient	k <sub>f</sub> = <input type="text" value="1.52"/>
Sum of All Loss Coefficients	k <sub>s</sub> = <input type="text" value="3.02"/> ft
<b>Headwater:</b>	
Inlet Control Headwater	HW <sub>I</sub> = <input type="text" value="0.90"/> ft
Outlet Control Headwater	HW <sub>O</sub> = <input type="text" value="N/A"/> ft
<b>Design Headwater Elevation</b>	<b>HW = <input type="text" value="N/A"/> ft</b>
<b>Headwater/Diameter <b>OR</b> Headwater/Rise Ratio</b>	<b>HW/D = <input type="text" value="N/A"/></b>
Outlet Control Headwater Approximation Method Inaccurate for Low Flow - Backwater Calculations Required	
<b>Outlet Protection:</b>	
Flow/(Diameter <sup>2.5</sup> )	Q/D <sup>2.5</sup> = <input type="text" value="1.47"/> ft <sup>0.5</sup> /s
Tailwater Surface Height	Y <sub>t</sub> = <input type="text" value="0.80"/> ft
Tailwater/Diameter	Y <sub>t</sub> /D = <input type="text" value="0.40"/>
Expansion Factor	1/(2*tan(Θ)) = <input type="text" value="6.25"/>
Flow Area at Max Channel Velocity	A <sub>t</sub> = <input type="text" value="1.67"/> ft <sup>2</sup>
Width of Equivalent Conduit for Multiple Barrels	W <sub>eq</sub> = <input type="text" value="-"/> ft
<b>Length of Riprap Protection</b>	<b>L<sub>p</sub> = <input type="text" value="6"/> ft</b>
<b>Width of Riprap Protection at Downstream End</b>	<b>T = <input type="text" value="3"/> ft</b>
Adjusted Diameter for Supercritical Flow	Da = <input type="text" value="1.08"/> ft
Minimum Theoretical Riprap Size	d <sub>50 min</sub> = <input type="text" value="3"/> in
Nominal Riprap Size	d <sub>50 nominal</sub> = <input type="text" value="6"/> in
<b>MHFD Riprap Type</b>	<b>Type = <input type="text" value="VL"/></b>

# DETERMINATION OF CULVERT HEADWATER AND OUTLET PROTECTION

*MHFD-Culvert, Version 4.00 (May 2020)*

**Project:** Salisbury Park North Phase 1

**ID:** DP16 - Basin OS1 Culvert - 5 Year



**Soil Type:**

Choose One:

- Sandy  
 Non-Sandy

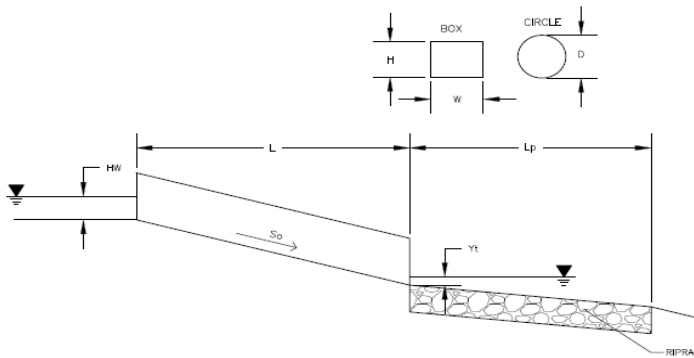
**Supercritical Flow! Using Adjusted Diameter to calculate protection type.**

Design Information:	
Design Discharge	Q = <input style="width: 100px;" type="text" value="2.51"/> cfs
<b>Circular Culvert:</b>	
Barrel Diameter in Inches	D = <input style="width: 100px;" type="text" value="24"/> inches
Inlet Edge Type (Choose from pull-down list)	Square Edge with Headwall
<b>OR:</b>	
<b>Box Culvert:</b>	
Barrel Height (Rise) in Feet	H (Rise) = <input style="width: 100px;" type="text"/> ft
Barrel Width (Span) in Feet	W (Span) = <input style="width: 100px;" type="text"/> ft
Inlet Edge Type (Choose from pull-down list)	
Number of Barrels	# Barrels = <input style="width: 100px;" type="text" value="1"/>
Inlet Elevation	Elev IN = <input style="width: 100px;" type="text" value="5843"/> ft
Outlet Elevation <b>OR</b> Slope	Elev OUT = <input style="width: 100px;" type="text" value="5840.4"/> ft
Culvert Length	L = <input style="width: 100px;" type="text" value="109"/> ft
Manning's Roughness	n = <input style="width: 100px;" type="text" value="0.013"/>
Bend Loss Coefficient	k <sub>b</sub> = <input style="width: 100px;" type="text" value="0"/>
Exit Loss Coefficient	k <sub>x</sub> = <input style="width: 100px;" type="text" value="1"/>
Tailwater Surface Elevation	Y <sub>t</sub> , Elevation = <input style="width: 100px;" type="text"/> ft
Max Allowable Channel Velocity	V = <input style="width: 100px;" type="text" value="5"/> ft/s
Calculated Results:	
Culvert Cross Sectional Area Available	A = <input style="width: 100px;" type="text" value="3.14"/> ft <sup>2</sup>
Culvert Normal Depth	Y <sub>n</sub> = <input style="width: 100px;" type="text" value="0.36"/> ft
Culvert Critical Depth	Y <sub>c</sub> = <input style="width: 100px;" type="text" value="0.55"/> ft
Froude Number	Fr = <input style="width: 100px;" type="text" value="2.27"/> <span style="color: red; font-weight: bold;">Supercritical!</span>
Entrance Loss Coefficient	k <sub>e</sub> = <input style="width: 100px;" type="text" value="0.50"/>
Friction Loss Coefficient	k <sub>f</sub> = <input style="width: 100px;" type="text" value="1.35"/>
Sum of All Loss Coefficients	k <sub>s</sub> = <input style="width: 100px;" type="text" value="2.85"/> ft
<b>Headwater:</b>	
Inlet Control Headwater	HW <sub>I</sub> = <input style="width: 100px;" type="text" value="0.74"/> ft
Outlet Control Headwater	HW <sub>O</sub> = <input style="width: 100px;" type="text" value="N/A"/> ft
<b>Design Headwater Elevation</b>	<b>HW = <input style="width: 100px;" type="text" value="N/A"/> ft</b>
<b>Headwater/Diameter <b>OR</b> Headwater/Rise Ratio</b>	<b>HW/D = <input style="width: 100px;" type="text" value="N/A"/></b>
Outlet Control Headwater Approximation Method Inaccurate for Low Flow - Backwater Calculations Required	
<b>Outlet Protection:</b>	
Flow/(Diameter <sup>2.5</sup> )	Q/D <sup>2.5</sup> = <input style="width: 100px;" type="text" value="0.44"/> ft <sup>0.5</sup> /s
Tailwater Surface Height	Y <sub>t</sub> = <input style="width: 100px;" type="text" value="0.80"/> ft
Tailwater/Diameter	Y <sub>t</sub> /D = <input style="width: 100px;" type="text" value="0.40"/>
Expansion Factor	1/(2*tan(Θ)) = <input style="width: 100px;" type="text" value="6.70"/>
Flow Area at Max Channel Velocity	A <sub>t</sub> = <input style="width: 100px;" type="text" value="0.50"/> ft <sup>2</sup>
Width of Equivalent Conduit for Multiple Barrels	W <sub>eq</sub> = <input style="width: 100px;" type="text" value="-"/> ft
<b>Length of Riprap Protection</b>	<b>L<sub>p</sub> = <input style="width: 100px;" type="text" value="6"/> ft</b>
<b>Width of Riprap Protection at Downstream End</b>	<b>T = <input style="width: 100px;" type="text" value="3"/> ft</b>
Adjusted Diameter for Supercritical Flow	Da = <input style="width: 100px;" type="text" value="1.18"/> ft
Minimum Theoretical Riprap Size	d <sub>50</sub> min = <input style="width: 100px;" type="text" value="1"/> in
Nominal Riprap Size	d <sub>50</sub> nominal = <input style="width: 100px;" type="text" value="6"/> in
<b>MHFD Riprap Type</b>	<b>Type = <input style="width: 100px;" type="text" value="VL"/></b>

# DETERMINATION OF CULVERT HEADWATER AND OUTLET PROTECTION

*MHFD-Culvert, Version 4.00 (May 2020)*

**Project:** Salisbury Park North Phase 1  
**ID:** DP16 - Basin OS1 Culvert - 100 Year



**Soil Type:**

Choose One:

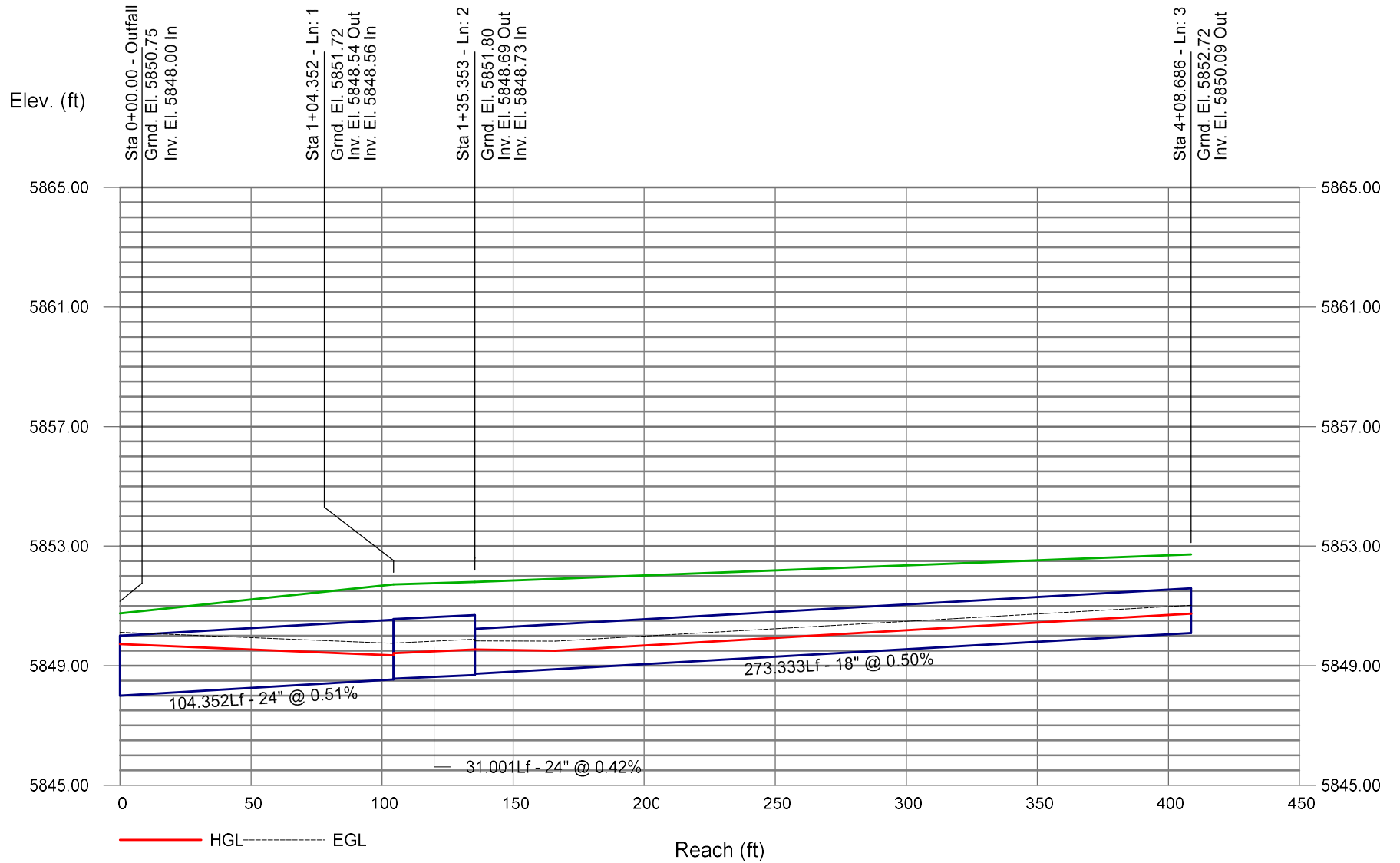
- Sandy  
 Non-Sandy

**Supercritical Flow! Using Adjusted Diameter to calculate protection type.**

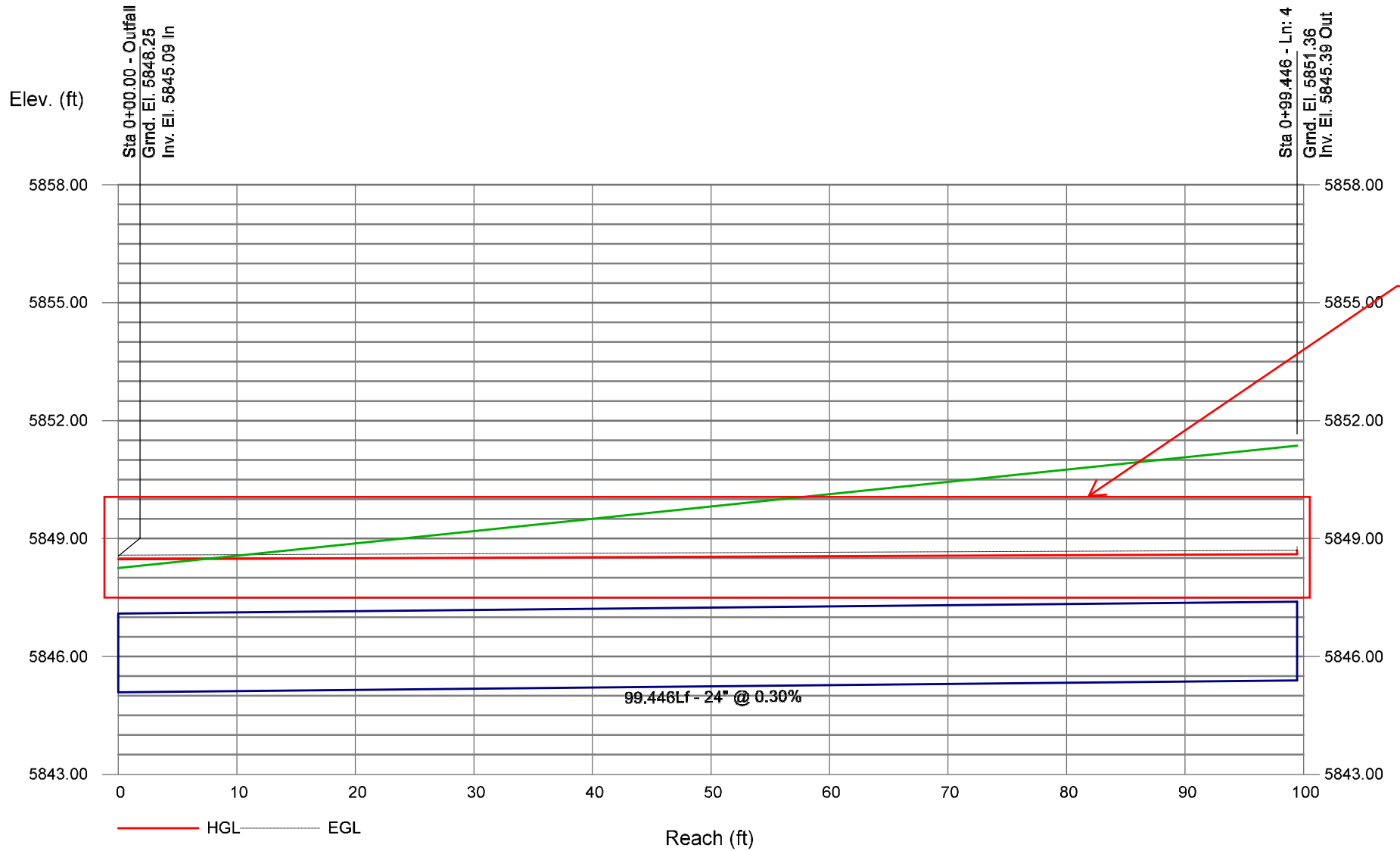
Design Information:	
Design Discharge	Q = <input type="text" value="18.59"/> cfs
<b>Circular Culvert:</b>	
Barrel Diameter in Inches	D = <input type="text" value="24"/> inches
Inlet Edge Type (Choose from pull-down list)	Grooved Edge Projecting
<b>OR:</b>	
<b>Box Culvert:</b>	
Barrel Height (Rise) in Feet	H (Rise) = <input type="text"/> ft
Barrel Width (Span) in Feet	W (Span) = <input type="text"/> ft
Inlet Edge Type (Choose from pull-down list)	
Number of Barrels	# Barrels = <input type="text" value="1"/>
Inlet Elevation	Elev IN = <input type="text" value="5843"/> ft
Outlet Elevation <b>OR</b> Slope	Elev OUT = <input type="text" value="5840.4"/> ft
Culvert Length	L = <input type="text" value="109"/> ft
Manning's Roughness	n = <input type="text" value="0.013"/>
Bend Loss Coefficient	k <sub>b</sub> = <input type="text" value="0"/>
Exit Loss Coefficient	k <sub>x</sub> = <input type="text" value="1"/>
Tailwater Surface Elevation	Y <sub>t</sub> , Elevation = <input type="text"/> ft
Max Allowable Channel Velocity	V = <input type="text" value="5"/> ft/s
Calculated Results:	
Culvert Cross Sectional Area Available	A = <input type="text" value="3.14"/> ft <sup>2</sup>
Culvert Normal Depth	Y <sub>n</sub> = <input type="text" value="1.04"/> ft
Culvert Critical Depth	Y <sub>c</sub> = <input type="text" value="1.55"/> ft
Froude Number	Fr = <input type="text" value="2.20"/> <span style="color: red;">Supercritical!</span>
Entrance Loss Coefficient	k <sub>e</sub> = <input type="text" value="0.20"/>
Friction Loss Coefficient	k <sub>f</sub> = <input type="text" value="1.35"/>
Sum of All Loss Coefficients	k <sub>s</sub> = <input type="text" value="2.55"/> ft
<b>Headwater:</b>	
Inlet Control Headwater	HW <sub>I</sub> = <input type="text" value="2.47"/> ft
Outlet Control Headwater	HW <sub>O</sub> = <input type="text" value="N/A"/> ft
<b>Design Headwater Elevation</b>	<b>HW = <input type="text" value="5845.47"/> ft</b>
<b>Headwater/Diameter OR Headwater/Rise Ratio</b>	<b>HW/D = <input type="text" value="1.23"/></b>
<b>Outlet Control Headwater Approximation Method Inaccurate for Low Flow - Backwater Calculations Required</b>	
<b>Outlet Protection:</b>	
Flow/(Diameter <sup>2.5</sup> )	Q/D <sup>2.5</sup> = <input type="text" value="3.29"/> ft <sup>0.5</sup> /s
Tailwater Surface Height	Y <sub>t</sub> = <input type="text" value="0.80"/> ft
Tailwater/Diameter	Y <sub>t</sub> /D = <input type="text" value="0.40"/>
Expansion Factor	1/(2*tan(θ)) = <input type="text" value="4.13"/>
Flow Area at Max Channel Velocity	A <sub>t</sub> = <input type="text" value="3.72"/> ft <sup>2</sup>
Width of Equivalent Conduit for Multiple Barrels	W <sub>eq</sub> = <input type="text" value="-"/> ft
<b>Length of Riprap Protection</b>	<b>L<sub>p</sub> = <input type="text" value="11"/> ft</b>
<b>Width of Riprap Protection at Downstream End</b>	<b>T = <input type="text" value="5"/> ft</b>
Adjusted Diameter for Supercritical Flow	Da = <input type="text" value="1.52"/> ft
Minimum Theoretical Riprap Size	d <sub>50</sub> min = <input type="text" value="6"/> in
Nominal Riprap Size	d <sub>50</sub> nominal = <input type="text" value="6"/> in
<b>MHFD Riprap Type</b>	<b>Type = <input type="text" value="VL"/></b>

# HYDRAULIC PIPE ANALYSIS

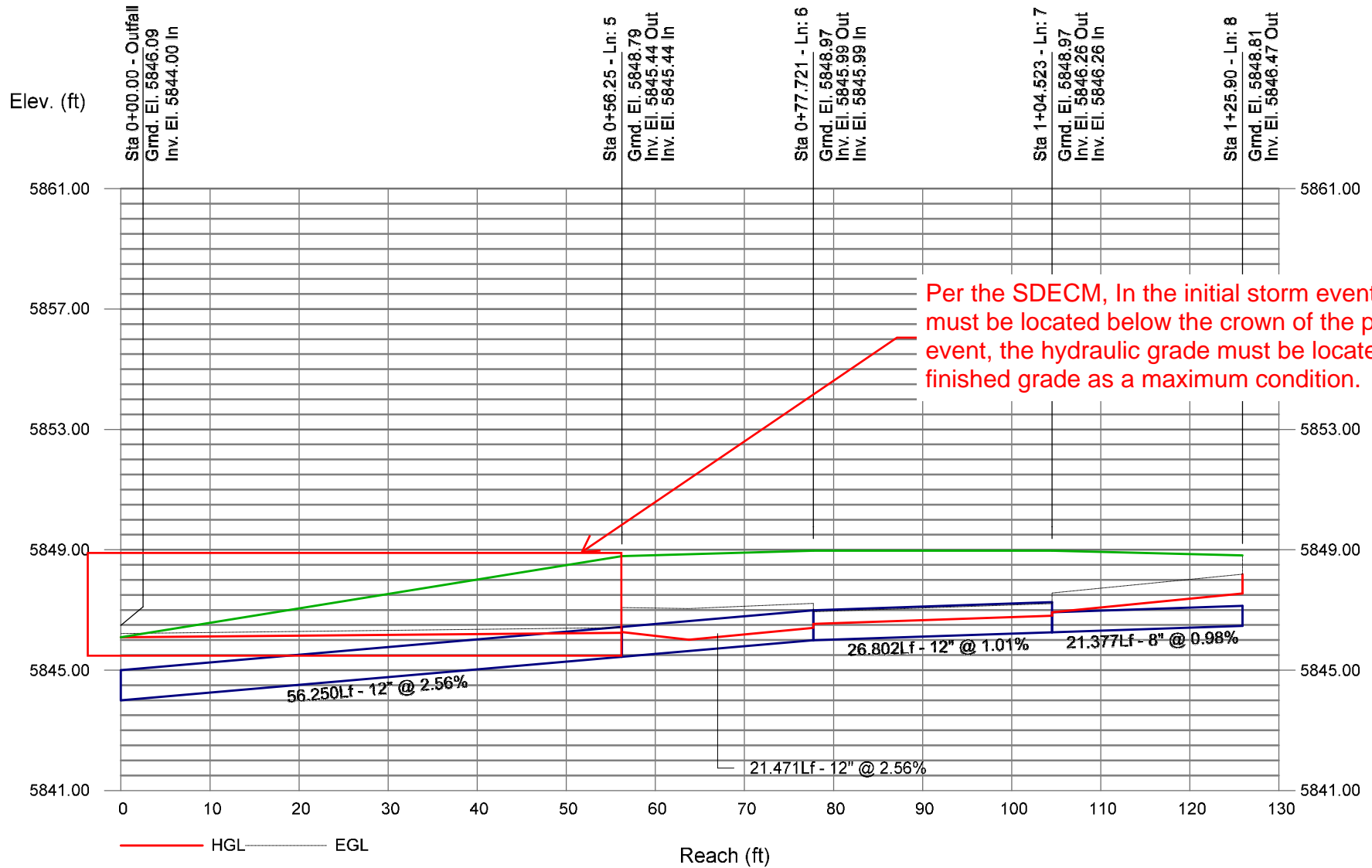
# Storm Sewer Profile



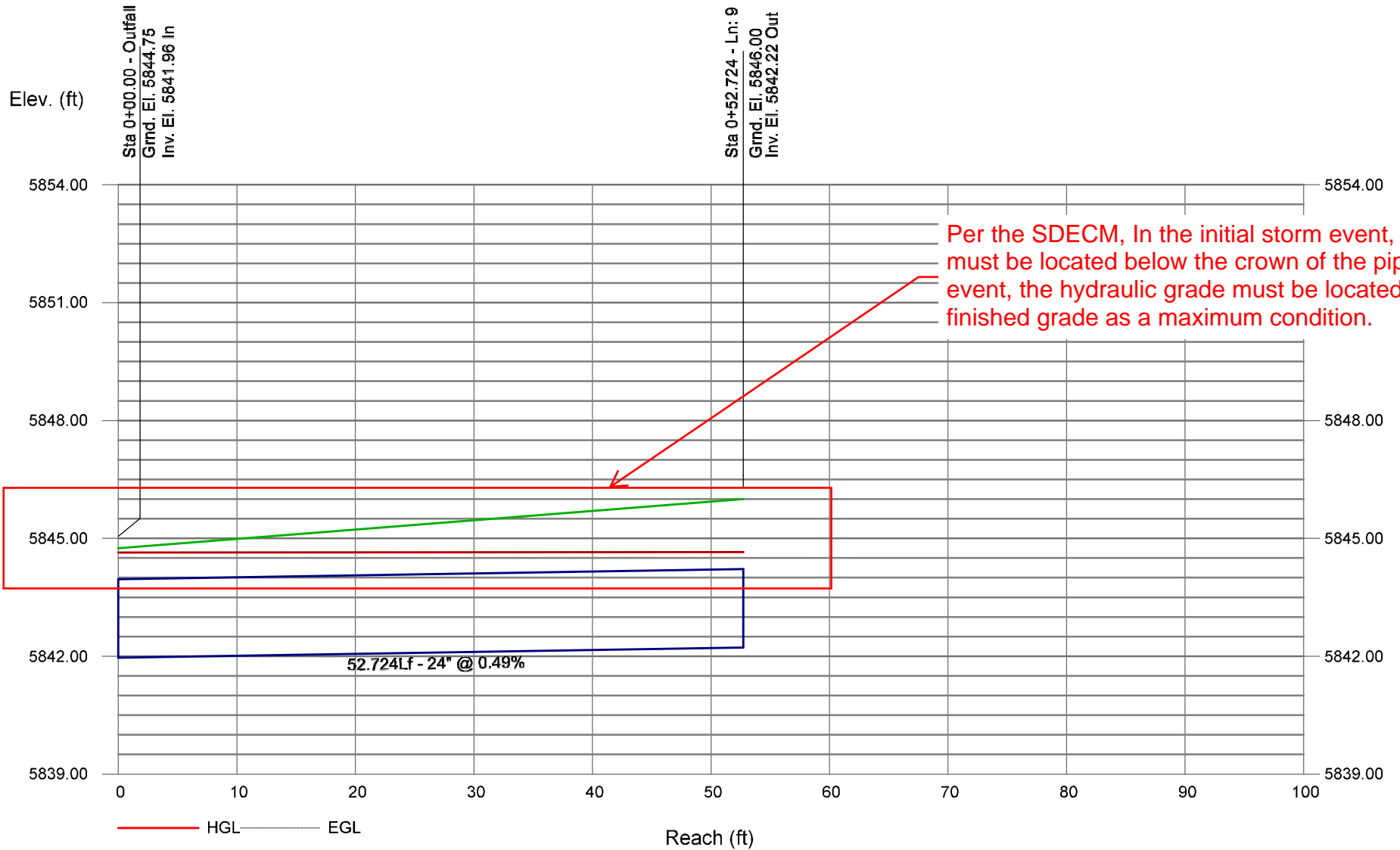
# Storm Sewer Profile



# Storm Sewer Profile

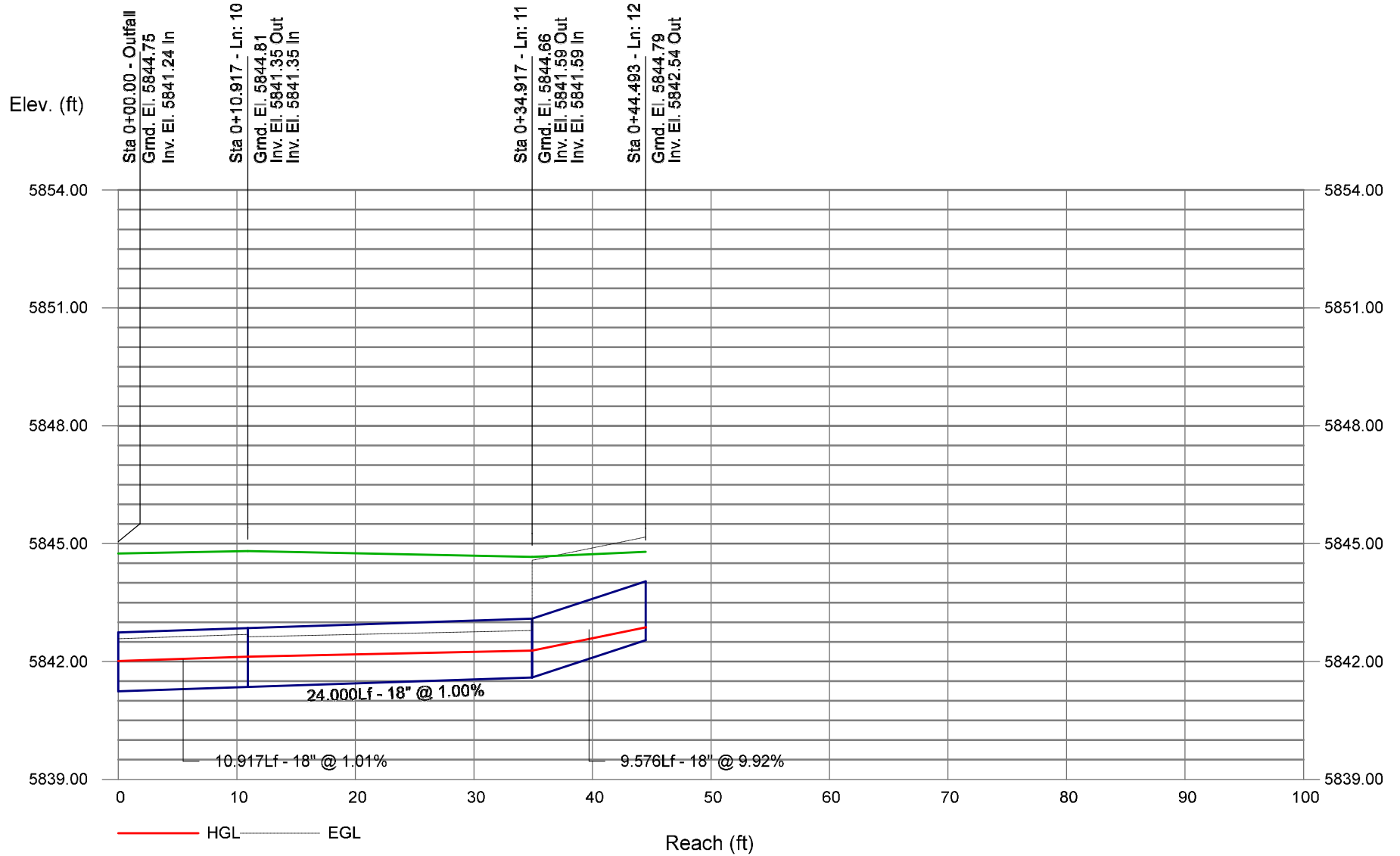


# Storm Sewer Profile

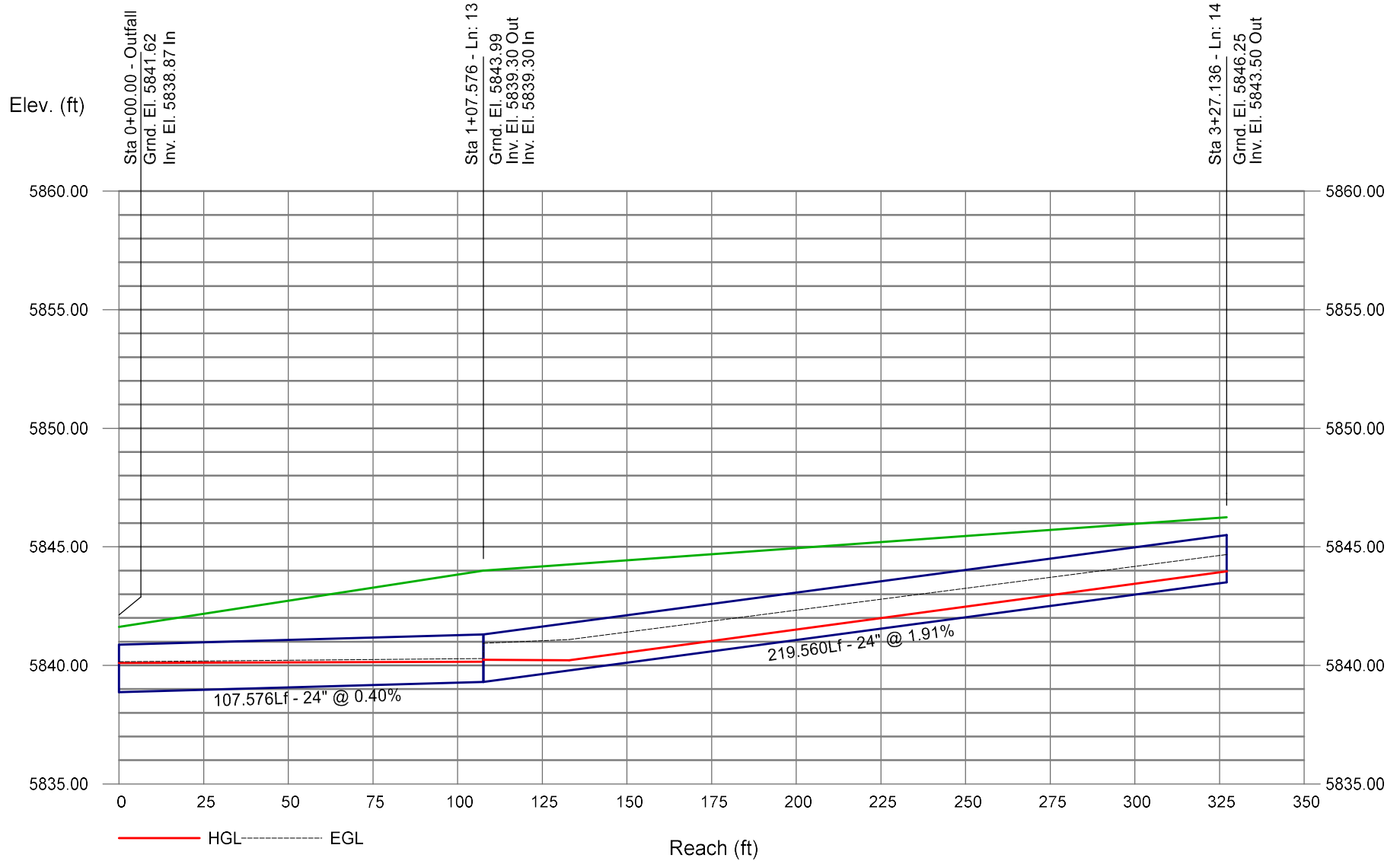


Per the SDECM, In the initial storm event, the hydraulic grade line must be located below the crown of the pipe; In the final storm event, the hydraulic grade line must be located 12-inches above the finished grade as a maximum condition.

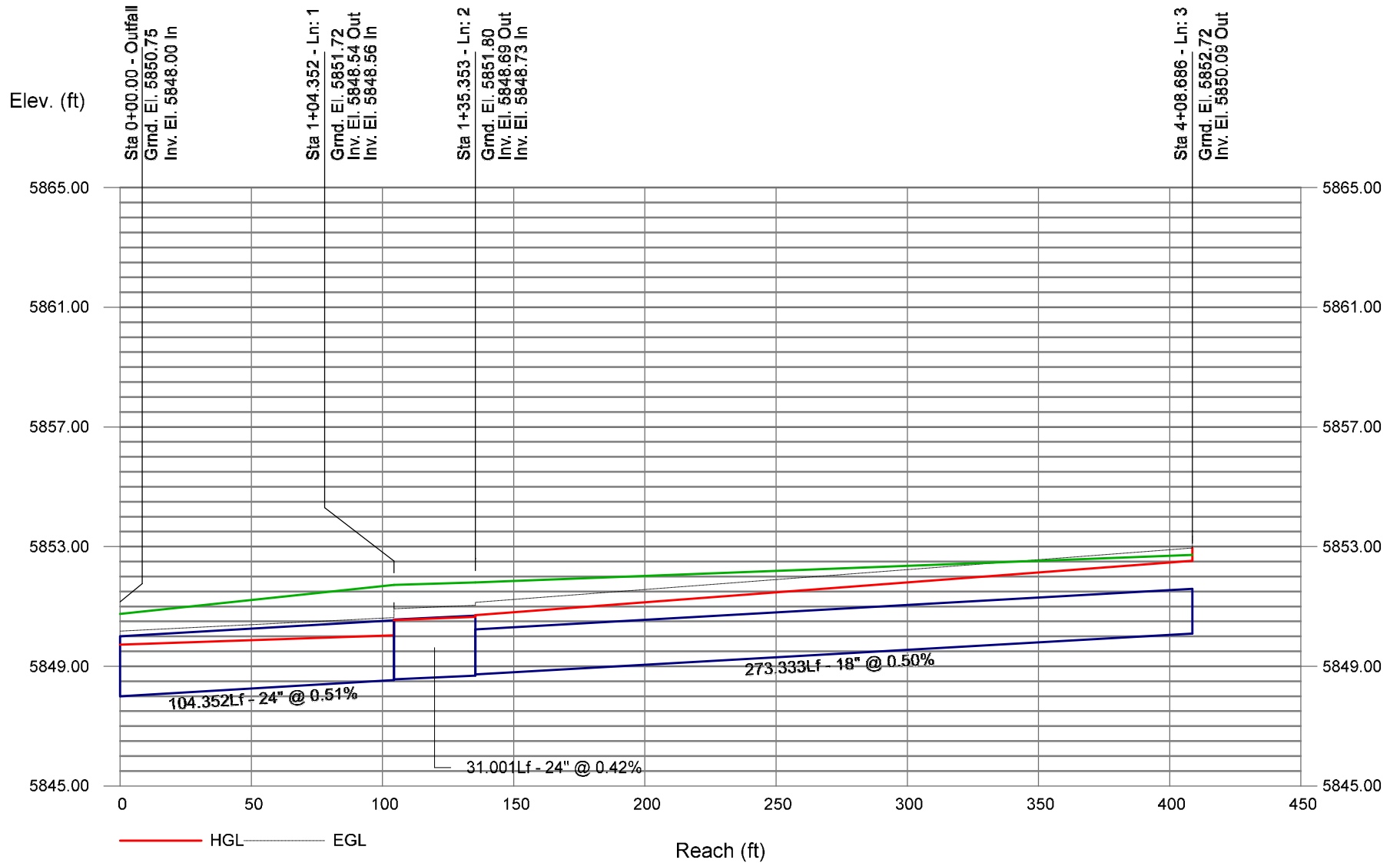
# Storm Sewer Profile



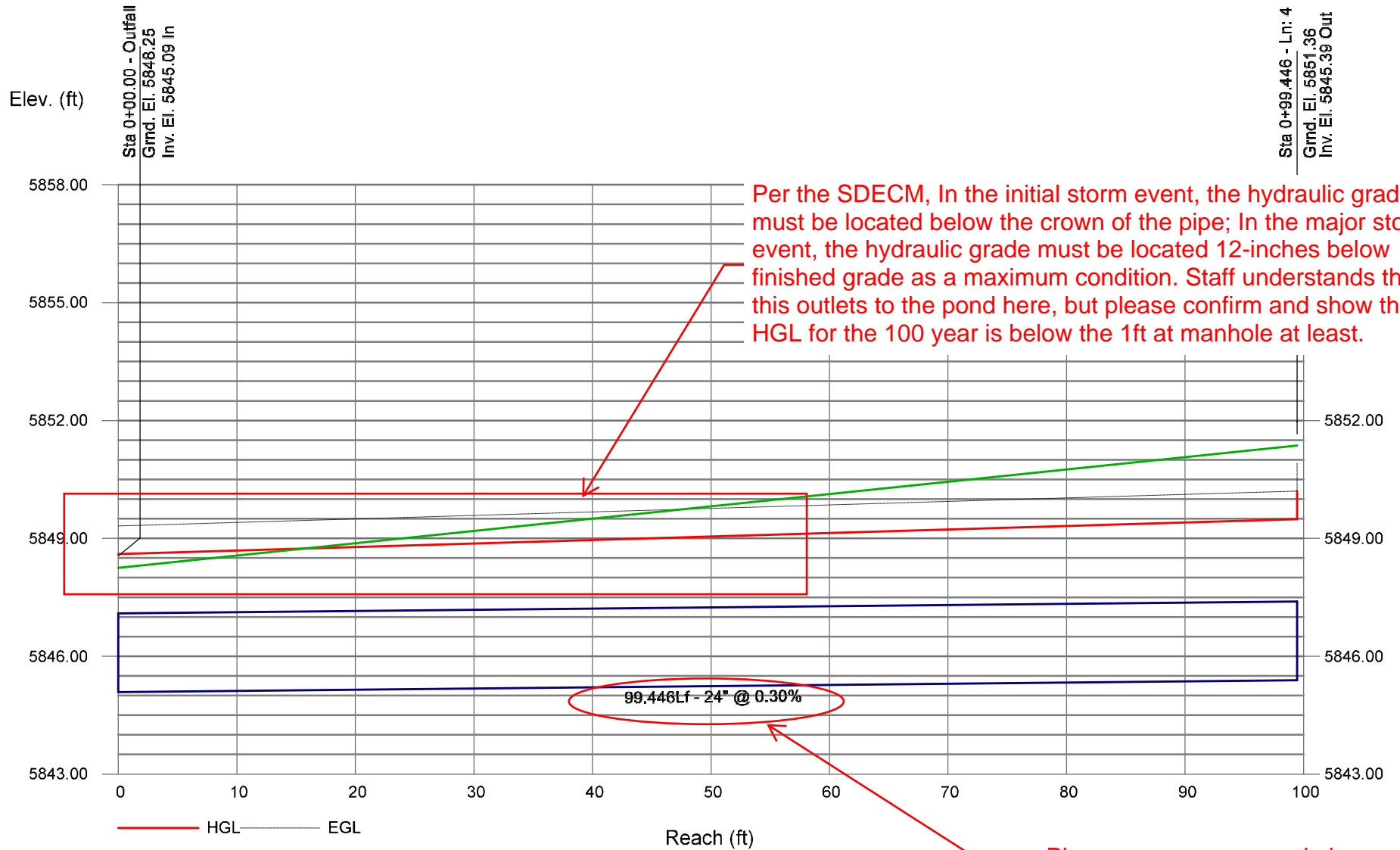
# Storm Sewer Profile



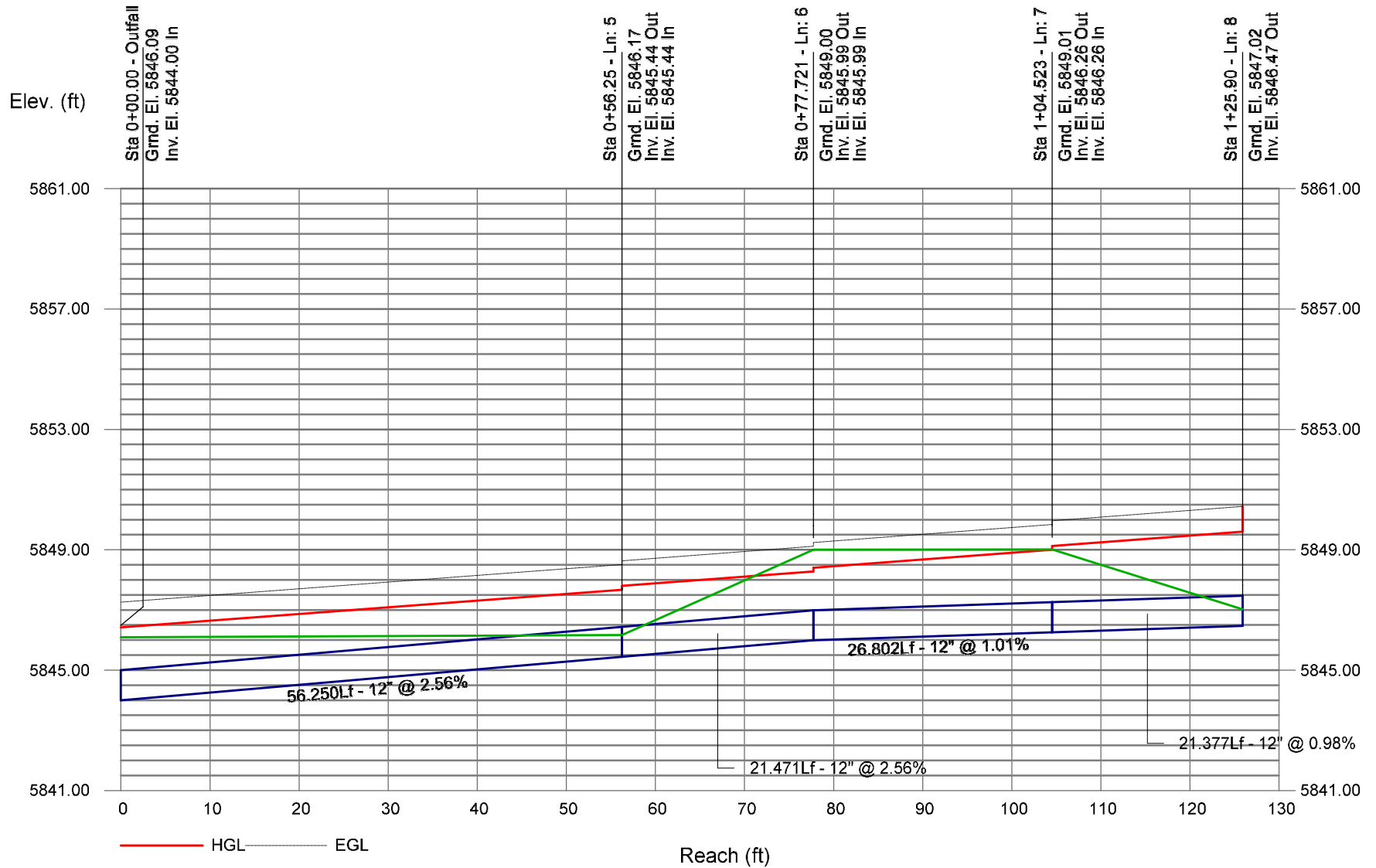
# Storm Sewer Profile



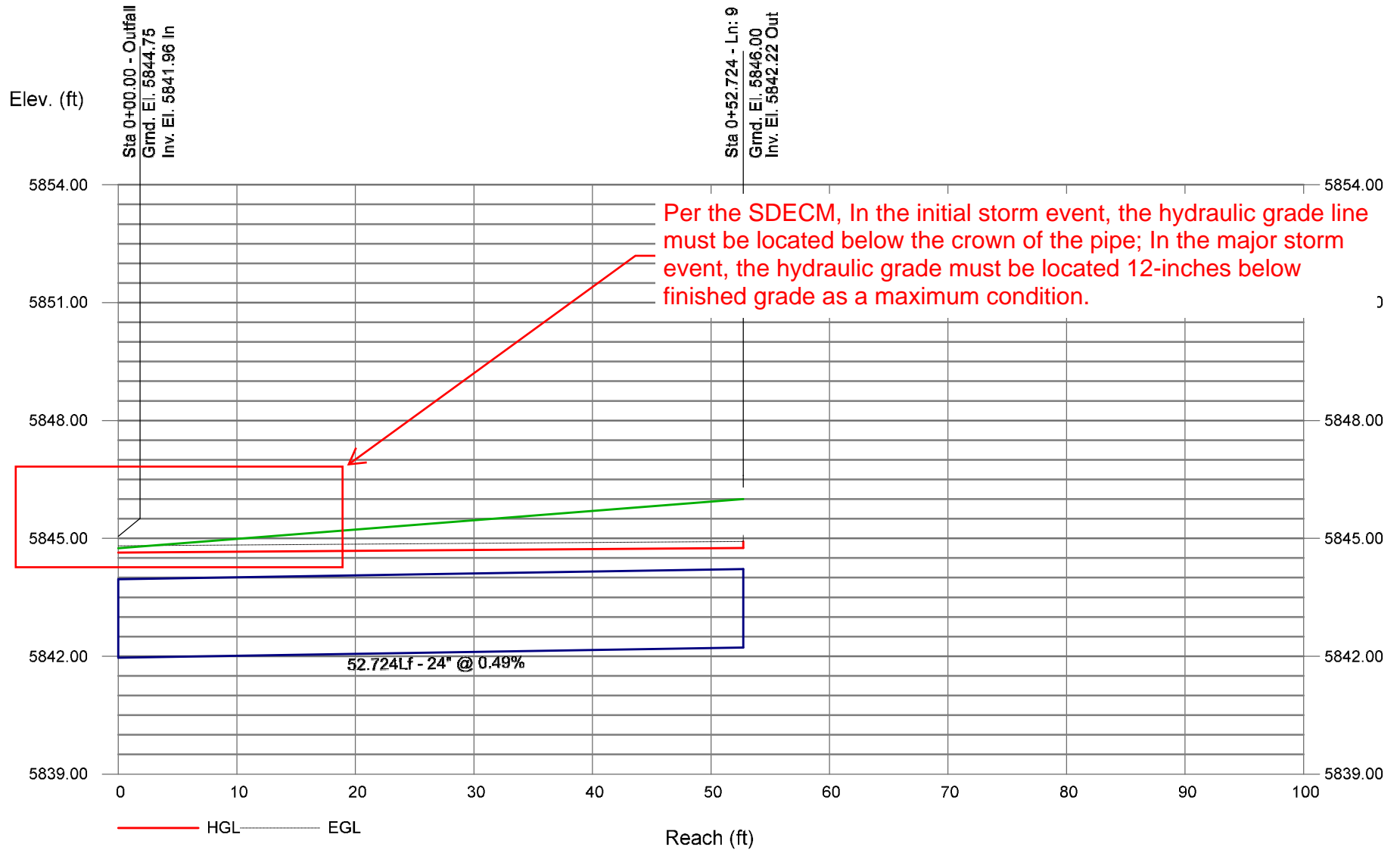
# Storm Sewer Profile



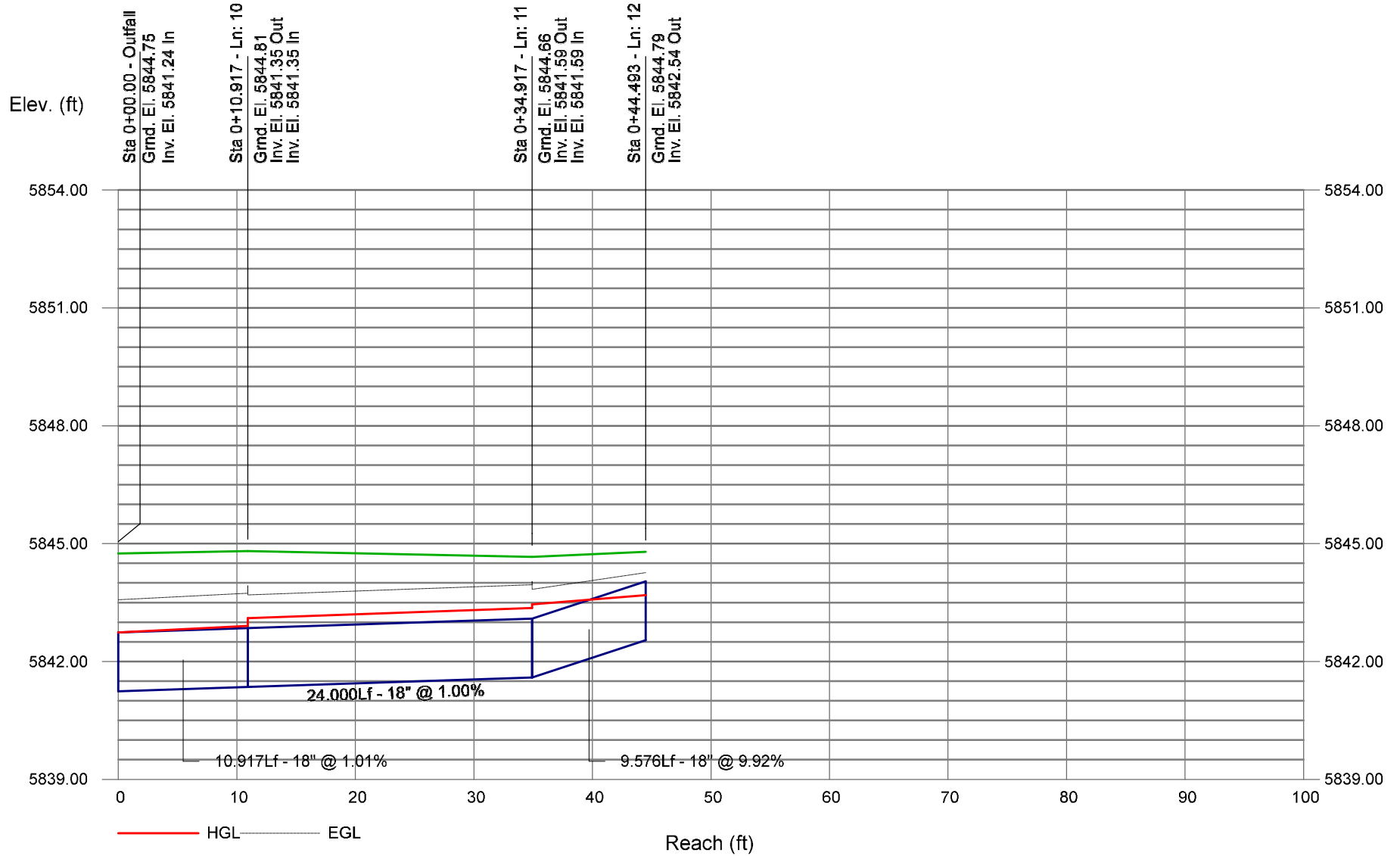
# Storm Sewer Profile



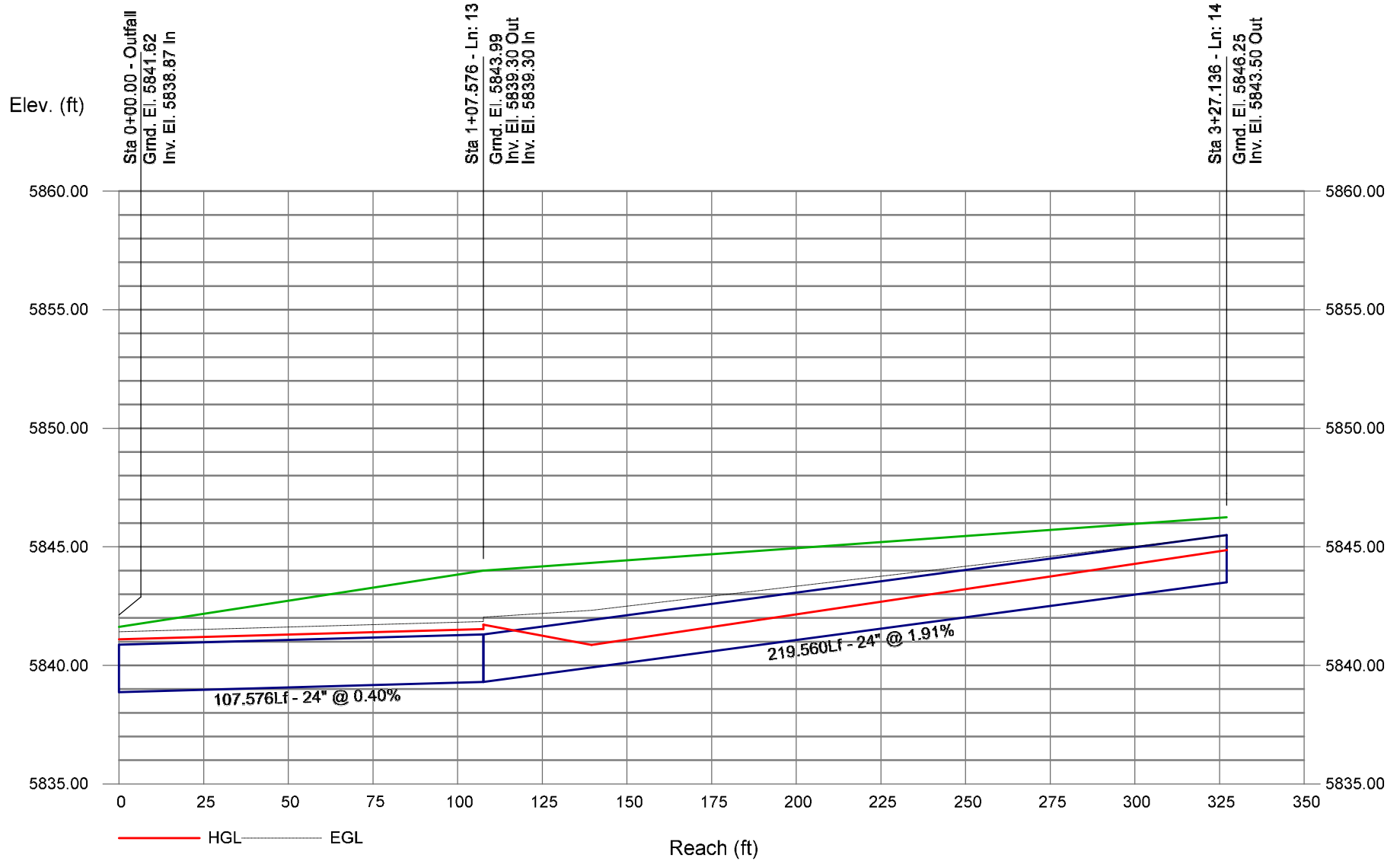
# Storm Sewer Profile



# Storm Sewer Profile



# Storm Sewer Profile



## APPENDIX D – MAPPING

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